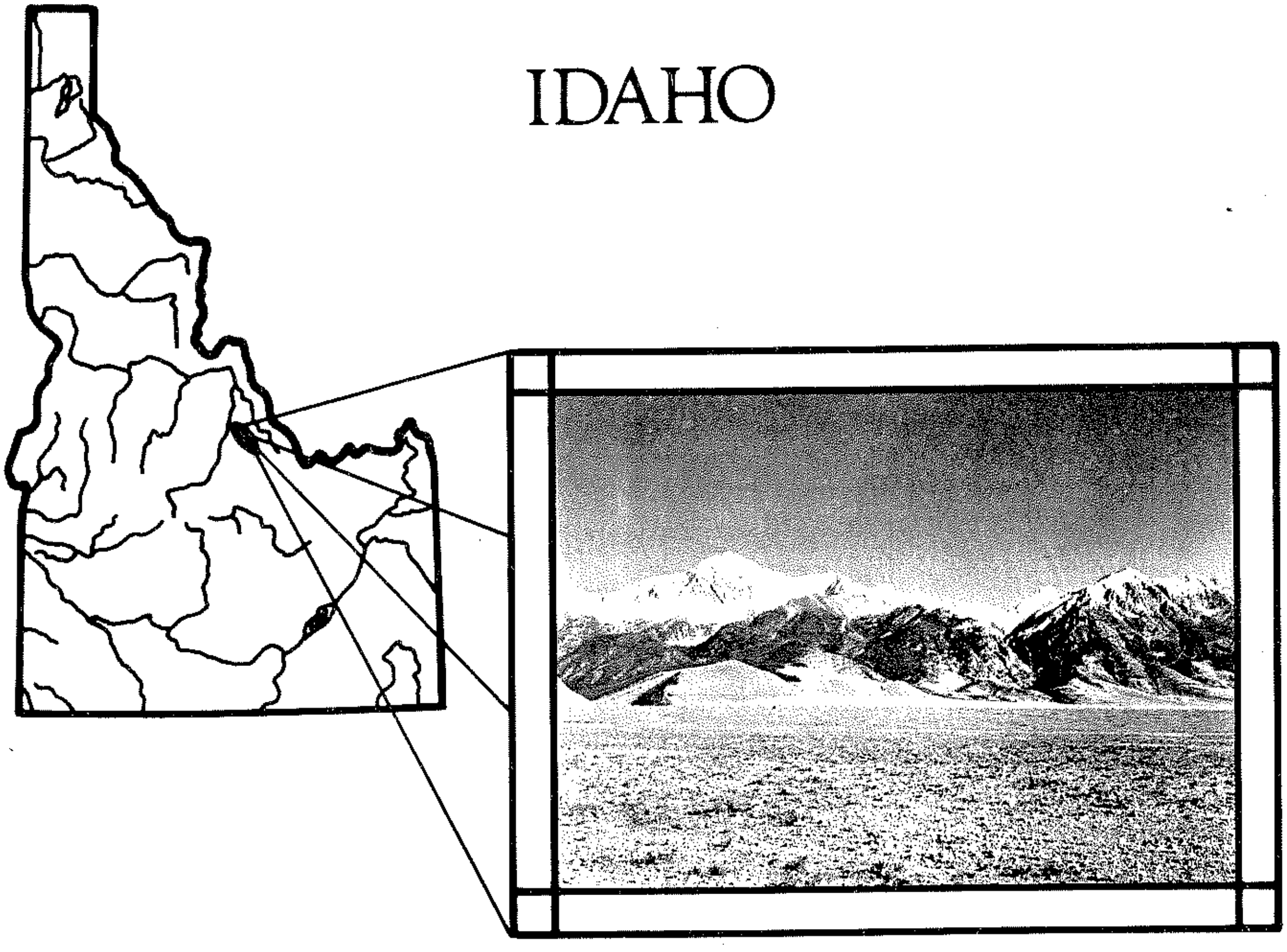
A RECONNAISSANCE of the WATER RESOURCES of the PAHSIMEROI RIVER BASIN, IDAHO



IDAHO DEPARTMENT OF WATER ADMINISTRATION

WATER INFORMATION BULLETIN NO. 31

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A RECONNAISSANCE OF THE WATER RESOURCES IN THE PAHSIMEROI RIVER BASIN, IDAHO

by

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Prepared by the United States Geological Survey

in cooperation with

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ABSTRACT

The Pahsimeroi River basin occupies approximately 845 square miles of east-central Idaho and is tributary to the Salmon River. The economy of the basin is dependent primarily upon livestock raising which in turn is dependent upon irrigation of lands for hay and pasture.

A distinctive feature of the basin is the large interchange of water from the surface to the subsurface and back again to the surface. Water from the surrounding mountains seldom reaches the Pahsimeroi River as direct overland runoff. The Pahsimeroi River is principally a ground-water fed stream with maximum mean monthly flows occurring in November and minimum mean monthly flows occurring in May. Surface-water runoff is several orders of magnitude higher from the Lemhi Range to the northeast than from the Lost River Range to the southwest.

The principal aquifer in the basin is the alluvial fill from which measured well yields are as high as 3,850 gallons per minute. Geophysical studies indicate that the valley bedrock floor resembles a closed basin in which the alluvial fill ranges in depth from a few tens of feet near the mouth to about 3,000 feet in the central part of the basin.

The major use of water is for irrigation. In 1971, about 120,000 acre-feet of surface water and about 930 acre-feet of ground water were used to irrigate approximately 27,000 acres.

Both the surface and ground waters of the basin are of good chemical quality and are suitable for all present uses.

Future agricultural development in the basin must rely on the development of its ground-water supplies.

INTRODUCTION

The Pahsimeroi River basin is located in east-central Idaho (fig. 1) and has a drainage area of about 845 square miles. It is typical of the northern Rocky Mountain basins of central Idaho in that it is an intermontane basin in which the valley floor is surrounded by high mountain peaks. The basin is sparsely settled with a population of about 300 in 1970. The economy of the basin is almost entirely dependent upon irrigated agriculture and to a lesser extent on hunting and fishing. The chief crops grown are alfalfa and pasture grasses which are used to support a local livestock industry. Because the local economy is and probably will be almost entirely supported by irrigated agriculture, the water resources of the basin are of vital concern to its inhabitants. For this reason, an understanding of the occurrence of the basin's water resources, the quantity and quality available, and the potential for additional use is of considerable interest to local water users and administrators, and should aid future development of the basin.

The purposes of this report are, therefore, to: (1) describe a reconnaissance appraisal of the water resources available to the basin including the chemical quality and present use of these waters and (2) establish a data collection network that will provide continuing information on surface-water flows, ground-water levels, and water quality.

This reconnaissance of the water resources of the Pahsimeroi River basin was made by the U. S. Geological Survey in cooperation with the Idaho Department of Water Administration. It is a part of a continuing cooperative program by these agencies whereby the water resources of Idaho are being measured and described.

A significant part of the information presented in this report was supplied by residents in the Pahsimeroi River valley. For this reason, the authors wish to express their gratitude to these residents for supplying pertinent information on their wells and surface-water supplies and for allowing access to their property.

Well- and Spring-Numbering System

The numbering system used by the Geological Survey in Idaho indicates the location of wells or springs within the official rectangular subdivision of the public lands, with reference to the Boise base line and meridian. The first two segments of the number designate the township and range. The third segment gives the section number, followed by three letters and a numeral, which indicate the quarter section, the 40-acre tract, the 10-acre tract, and the serial number of the well within the tract, respectively. Quarter sections are lettered a, b, c, and d in counterclockwise order from the northeast quarter of each section (fig. 2). Within the quarter sections, 40-acre and 10-acre tracts are lettered in the same manner. Well 15N-21E-25daa1 is in the NE¼NE¼SE¼ sec. 25, T. 15 N., R. 21 E., and was the first well inventoried in that tract. Springs are designated by the letter "S" following the last numeral.

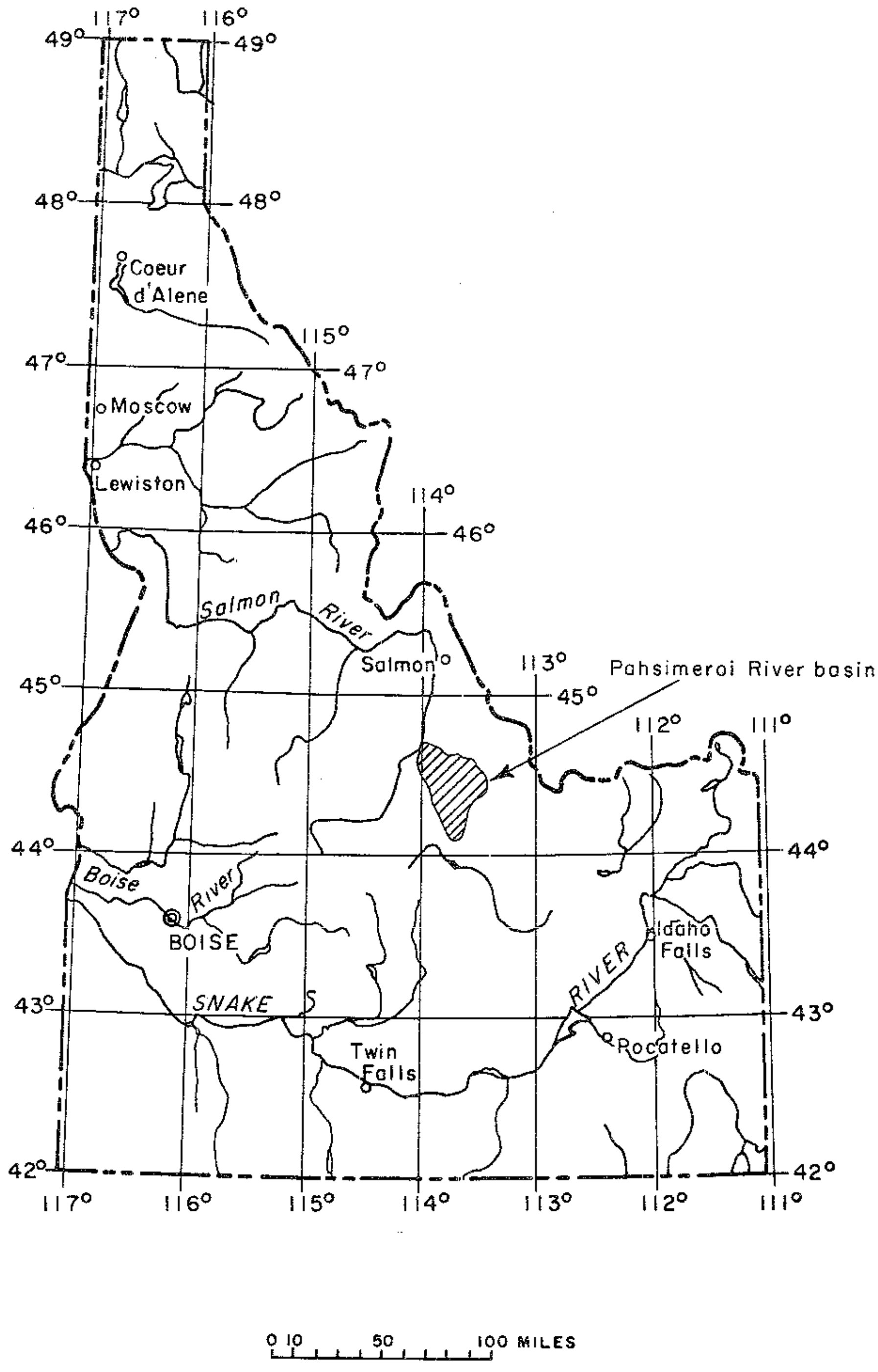

FIGURE 1. Index map showing area covered by this report.

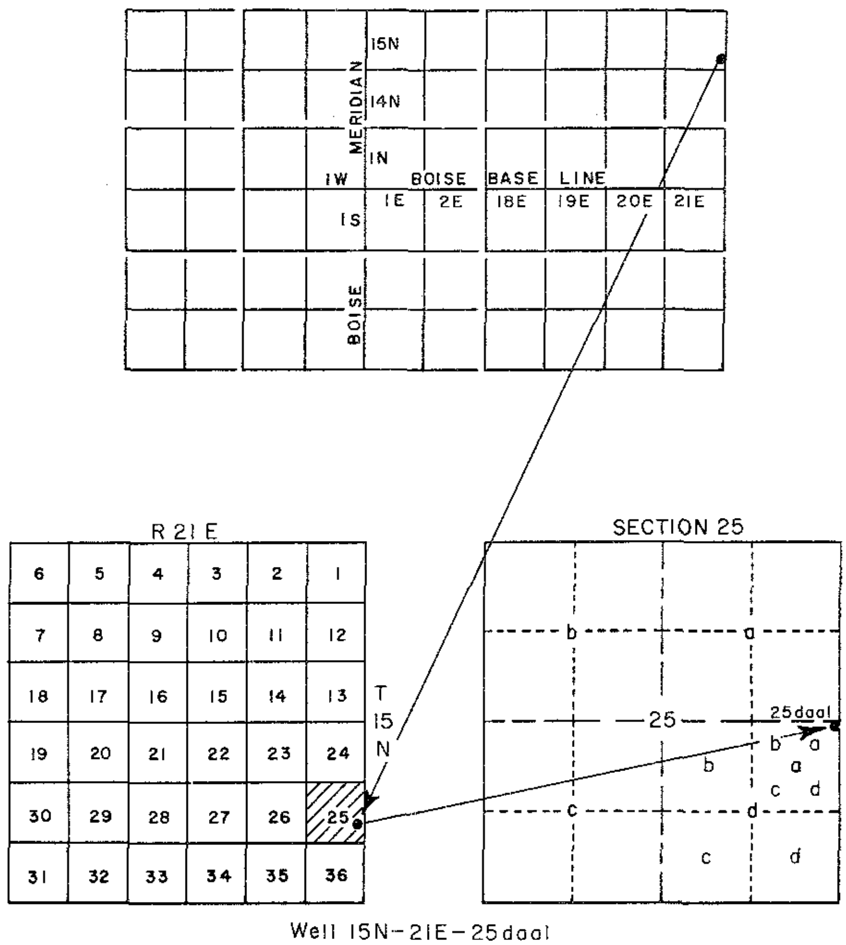

FIGURE 2. **Diagram showing the well- and spring-numbering system. (Using well 15N-21E-25daa1.)**

Gaging-Station-Numbering System

Each gaging station and a partial-record station in Idaho has been assigned a number in downstream order in accordance with the permanent numbering system used by the Geological Survey. Numbers are assigned in a downstream direction along the main stream, and stations on tributaries between main-stream stations are numbered in the order they enter the main stream. A similar order is followed on other ranks of tributaries. The complete 8-digit number, such as the number 13302000, which is used for the station "Pahsimeroi River near May," includes the part number "13", indicating that the Pahsimeroi River is in the Snake River basin, plus a 6-digit station number. Miscellaneous measurement sites are designated by the letter "M" preceding the station number.

Use of Metric Units

In this report, metric units are used to report concentrations of water-quality parameters determined by chemical analyses and temperatures of air and water. This change from reporting in English units has been made as a part of a gradual change to the metric system that is underway in the United States within the scientific community and is intended to promote greater uniformity in reporting of data. Chemical data for concentrations are reported in milligrams per liter (mg/l) rather than in parts per million (ppm), the units used in earlier reports of the U. S Geological Survey. However, numerical values for the relatively low chemical concentrations given in this report are the same whether reported in terms of milligrams per liter or parts per million. Air and water temperatures are reported in degrees Celsius (°C). As an aid to the readers, table 1 shows comparable temperatures in terms of both degrees Fahrenheit and degrees Celsius.

TABLE 1

TEMPERATURE-CONVERSION TABLE

Conversion of degrees Celsius (°C) to degrees Fahrenheit (°F) is based on the equation, °F = (1.8) (°C) + 32. Temperatures in °F are rounded to the nearest degree. Underscored equivalent temperatures are exact equivalents.

°C	°F	°C	°F	°C	°F	°C	°F
-<u>10</u>	<u>14</u>	<u>0</u>	<u>32</u>	<u>10</u>	<u>50</u>	<u>20</u>	<u>68</u>
-9	16	+1	34	11	52	21	70
-8	18	2	36	12	54	22	72
-7	19	3	37	13	55	23	73
-6	21	4	39	14	57	24	75
-<u>5</u>	<u>23</u>	<u>5</u>	<u>41</u>	<u>15</u>	<u>59</u>	<u>25</u>	<u>77</u>
-4	25	6	43	16	61	26	79
-3	27	7	45	17	63	27	81
-2	28	8	46	18	64	28	82
-1	30	9	48	19	66	29	84

PHYSICAL SETTING

Landforms and Drainage

The Pahsimeroi River drainage is in the Northern Rocky Mountain physiographic province (Fenneman, 1931, p. 1) and is typical of the basins common to this province. Like other catchments in this province, the Pahsimeroi River basin consists of a valley (flat or plain) surrounded by a rim of mountains (fig. 3). The basin trends north-northwest and is bounded by the Lemhi Range on the northeast, which rises to an altitude of 10,971 feet, and by the Lost River Range on the southwest, which rises to an altitude of 12,662 feet at Borah Peak, the highest point in Idaho. The divide between the Pahsimeroi and Little Lost River basins is formed by the Donkey Hills which rise to an altitude of 9,550 feet.

The valley floor has an average altitude of about 5,500 feet and ranges in width from less than 1 mile near its mouth to over 10 miles at its widest point. The valley is characterized by well-developed alluvial fans that extend from the mountain fronts to near the center of the valley floor where they coalesce.

The Pahsimeroi River drains an area of about 845 square miles and is tributary to the Salmon River. The river is about 50 miles long from the point where it meets the valley floor at an altitude of about 7,800 feet to its confluence with the Salmon River at an altitude of about 4,600 feet. Although the Pahsimeroi River is an intermittent stream in some of its upper reaches, ground-water inflow sustains a year-long flow throughout most of its reach.

Major tributaries to the Pahsimeroi River include Morgan, Morse, Falls, Patterson, Big, and Goldburg Creeks which drain the western slopes of the Lemhi Range; and Lawson, Sulphur, Meadow, Grouse, and Doublespring Creeks which drain the eastern slopes of the Lost River Range. Because of extensive irrigation diversions and large natural percolation losses to the coarse alluvium of the valley, these tributaries contribute surface water directly to the Pahsimeroi River only during periods of high surface-water runoff.

Climate

The climate of the Pahsimeroi River basin varies from cool arid to cold subhumid. Mean annual precipitation ranges from less than 8 inches on the valley floor to more than 30 inches at high points on the Lemhi and Lost River Ranges. Most of the precipitation in the mountains occurs as snow during the winter months. Data obtained from the National Weather Service station at May (fig. 4) show that the mean monthly precipitation on the valley floor ranges from a low of 0.30 inch in February and March to a high of 1.50 inches in June.

The typical freeze-free period is from mid-June to the end of August or approximately 75 days. Data obtained at the weather station in May (fig. 4) shows that mean monthly temperatures range from a low of -8°C in January to a high of 19°C in July.

The short growing season has limited the crops that can be grown in the valley to alfalfa and pasture grasses. These crops must be irrigated regularly throughout the growing

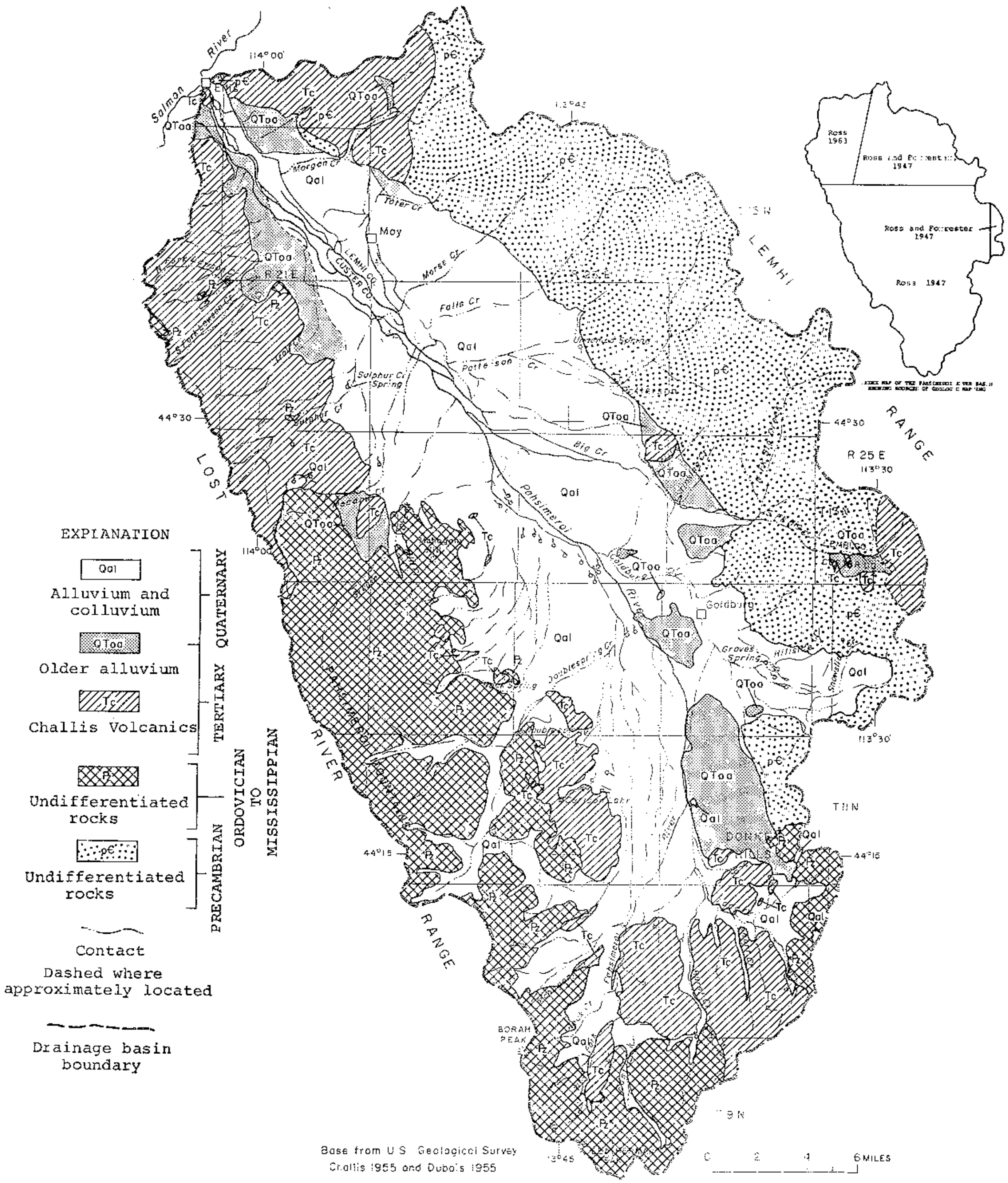

FIGURE 3. Map of the generalized geology in the Pahsimeroi River basin, Idaho.

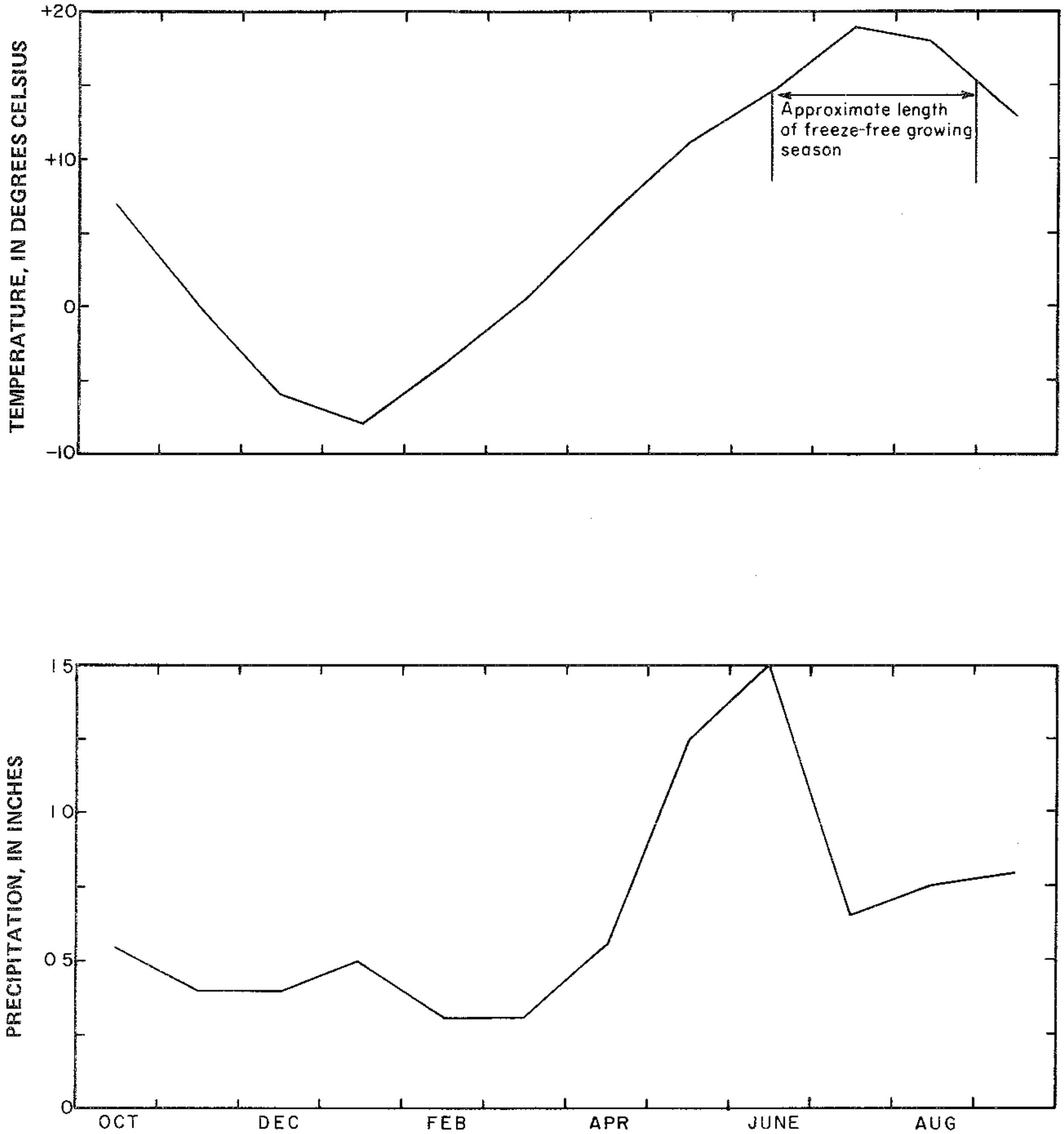

FIGURE 4. Mean monthly temperature and precipitation at May ranger station (based on data from National Weather Service 1936-70).

season because of the scant rainfall on the valley floor.

GEOLOGIC UNITS

For purposes of this report, the geologic materials underlying the Pahsimeroi River basin are divided into five units: Quartzitic rocks of Precambrian age, clastic and carbonate rocks of Paleozoic age, Challis Volcanics of Tertiary age, older alluvium of Tertiary and Quaternary age, and alluvium and colluvium of Quaternary age. The areal distribution of these units is shown in figure 3. Because detailed geologic mapping of the entire area is not available, figure 3 is highly generalized in some areas. The water-bearing characteristics and description of the various rock units are given in table 2.

Geophysical Studies

Gravity observations, electrical soundings, and seismic profiles by W. D. Stanley, D. L. Peterson, and W. E. Davis of the U. S. Geological Survey (written commun., 1971) indicate that the valley bedrock resembles a closed basin (fig. 5). The data suggest that the deepest part of the basin occurs near the axis of the valley between Patterson and Goldburg Creeks and is filled with about 3,000 feet of sediments. Near the southern end of the basin, the valley fill may be more than 1,200 feet thick, in contrast to the few tens of feet near the mouth (fig. 6).

Steep gravity gradients along the Lemhi Range (fig. 5) indicate high-angle faulting along this mountain front. This is in contrast to the flatter gradient observed along the Lost River Range and suggests that a pediment of pre-Tertiary rocks may underlie the alluvium. Undulations shown by the gravity contours suggest that a buried bedrock ridge extends northeastward from Mahogany Hill toward the axis of the valley.

WATER RESOURCES

The surface and ground waters of the Pahsimeroi River basin are so interrelated that, although they are herein described separately, for most practical purposes they constitute a single resource. Any use or control imposed on one is soon reflected on the other. The Pahsimeroi River and its tributaries lose most of their water to the alluvial fans, and consequently to the ground-water system, as they leave the mountains and enter the valley. Ground water reappearing at the surface near the mouth of the valley rather than continuous surface runoff is the source of most of the river flow leaving the basin.

TABLE 2

DESCRIPTION AND WATER-BEARING CHARACTERISTICS OF GEOLOGIC UNITS IN THE PAHSIMEROI RIVER BASIN

ERA	PERIOD	ROCK UNIT	DESCRIPTION	WATER-BEARING CHARACTERISTICS
Cenozoic	Quaternary	Alluvium and Colluvium	Clay, silt, sand, gravel, and boulders. Includes: glacial outwash deposits which merge with the alluvium and in places are covered by alluvial, landslide, and talus material on the steep mountain slopes; alluvial fans which consist of coarse gravel and boulders, poorly sorted and rounded, with sand in the interstices; and clay, silt, sand, and gravel in the river and stream channels and flood plains.	Saturated sand, gravel, and boulder beds are the major source of supply to wells. Irrigation wells yield as much as 3,850 gpm. Specific capacities* of irrigation wells range from 100 to 200.
Cenozoic	Quaternary and Tertiary	Older Alluvium	Gravels, sand, and silt of old alluvial fans and terraces. Includes Donkey Fanglomerate of Pliocene (?) age and similar unnamed deposits, composed largely of rounded to subangular, poorly sorted gravel, well indurated and locally cemented with calcite and quartz.	Little is known of water-bearing characteristics. Where saturated, of sufficient thickness and not cemented, this unit may provide small to moderate supplies to wells.
Cenozoic	Tertiary	Challis Volcanics	Latite-andesite, basalt, related flows, tuff, and associated rocks. Latite-andesite member is moderately light-colored in which shades of purple, gray, and green predominate; inconspicuously porphyritic and in some places is flow banded. Basalt and related flows are composed chiefly of brown and black fine-grained rocks with very small feldspar phenocrysts. Tuffaceous member is light-colored and composed chiefly of products of explosive volcanism.	Little is known of water-bearing characteristics. No known wells in the study area penetrate this unit; however, in adjacent valleys, this unit yields adequate supplies for domestic and stock purposes.
Paleozoic	Mississippian to Ordovician	Undifferentiated Rocks	Predominately limestone and dolomite with small shale and sandstone zones. Small and scattered outcrops of quartzite.	Carbonate rocks probably transmit water from catchment areas to the lowlands. Yields small to moderate amounts of water to springs.
Precambrian		Undifferentiated Rocks	Quartzite.	Yields small to moderate amounts of water to springs. Probably not an important aquifer.

* Well yield measured in gallons per minute per foot of water-level drawdown.

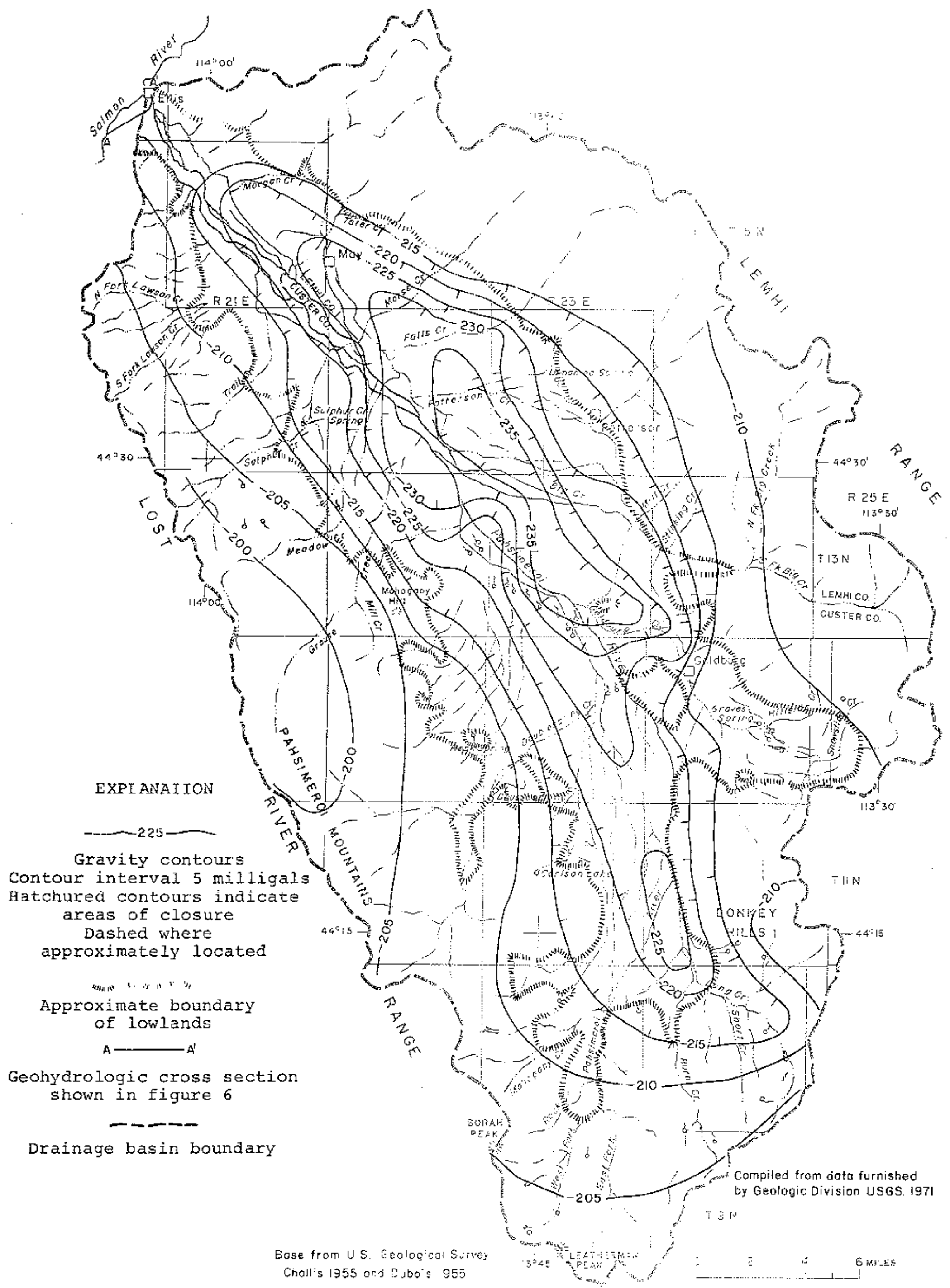

FIGURE 5. Map of the Pahsimeroi River basin showing gravity anomalies.

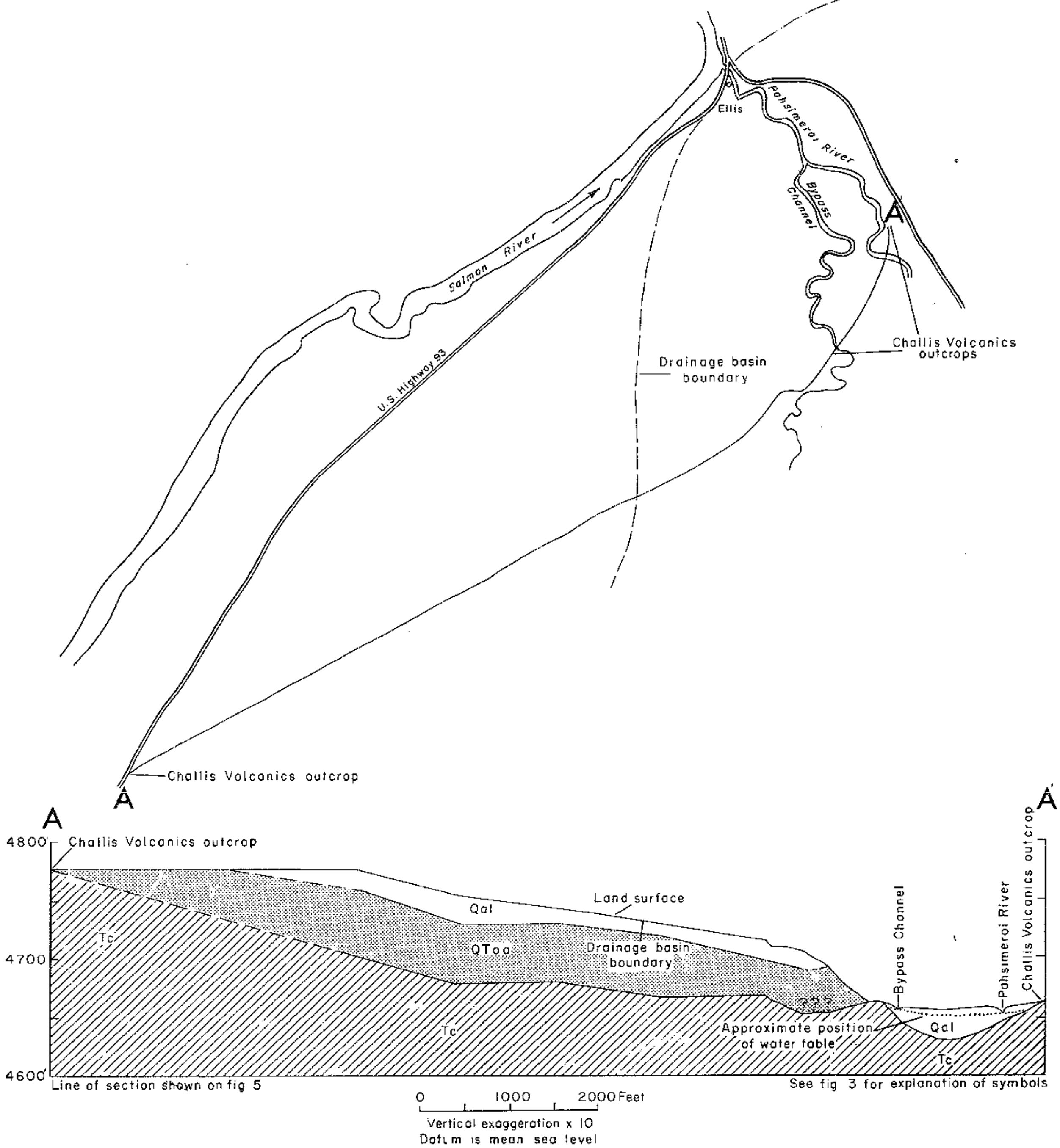

FIGURE 6. Geohydrologic section of the Pahsimeroi River valley.

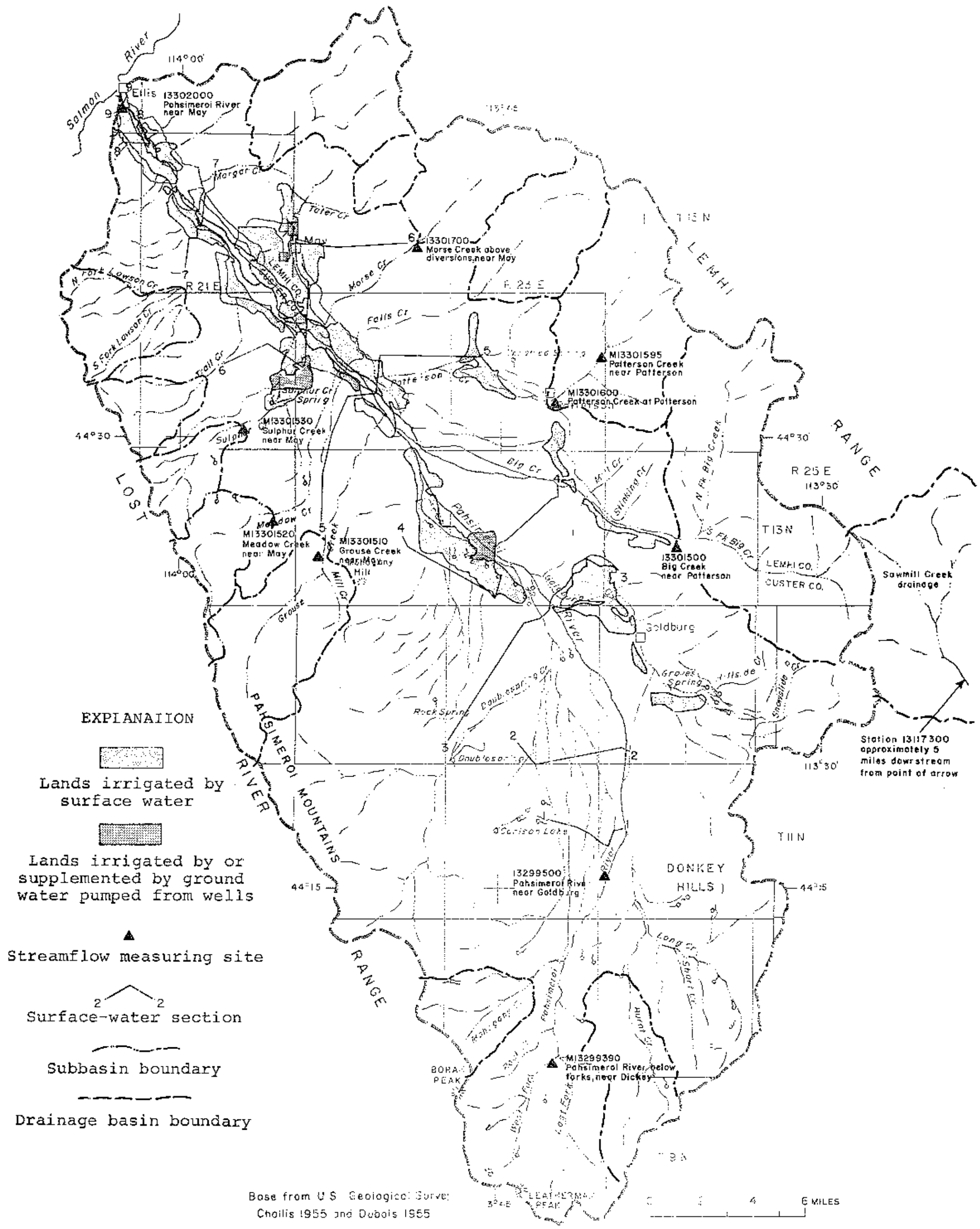

FIGURE 7. Map of Pahsimeroi River basin showing generalized extent of irrigated lands, streamflow measuring sites, and locations of surface-water sections.

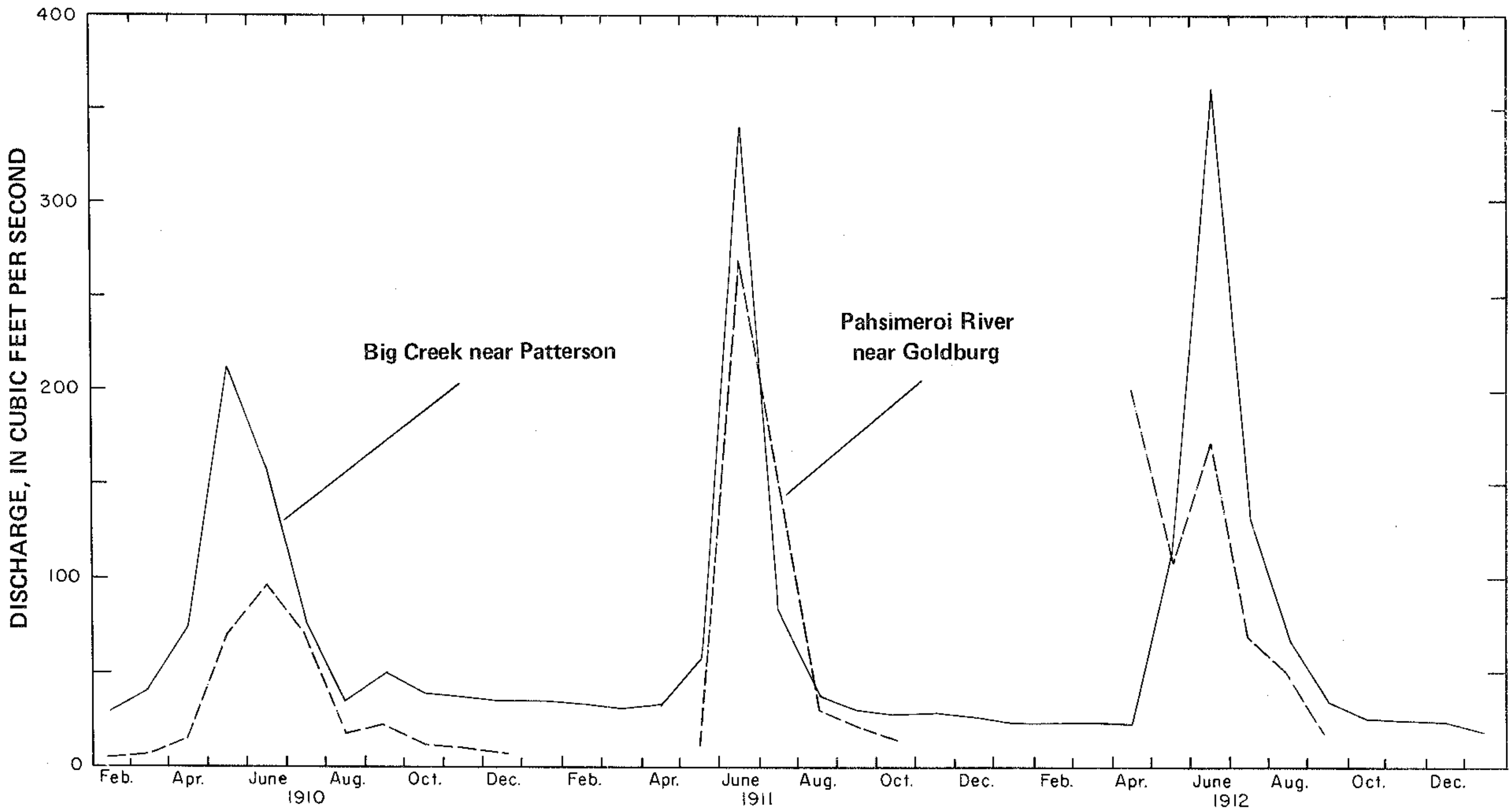

FIGURE 8. Monthly mean discharges at selected gaging stations, 1910-13.

Surface Water

Continuous-record gaging stations were maintained on the Pahsimeroi River and Big Creek for several years. Figure 7 shows the location of all surface-water gaging stations and the drainage pattern of the basin. Monthly mean discharge for the stations at the Pahsimeroi River near Goldburg and Big Creek near Patterson for 1910-13 are shown in figure 8. The higher discharges occurring in May and June are due to snowmelt.

Figure 9 shows the annual and mean monthly discharges at the Pahsimeroi River near May for water years 1930-59. Mean annual discharge for the 30 years of record is 212 cfs (cubic feet per second). Maximum mean monthly discharge (279 cfs) occurs in November while the minimum (133 cfs) is in May. The maximum daily discharge occurred during the fall or winter seasons in 20 of the 30 years of record. Low flows during the 1930's and considerably higher flows beginning in the early 1940's are evident from figure 9.

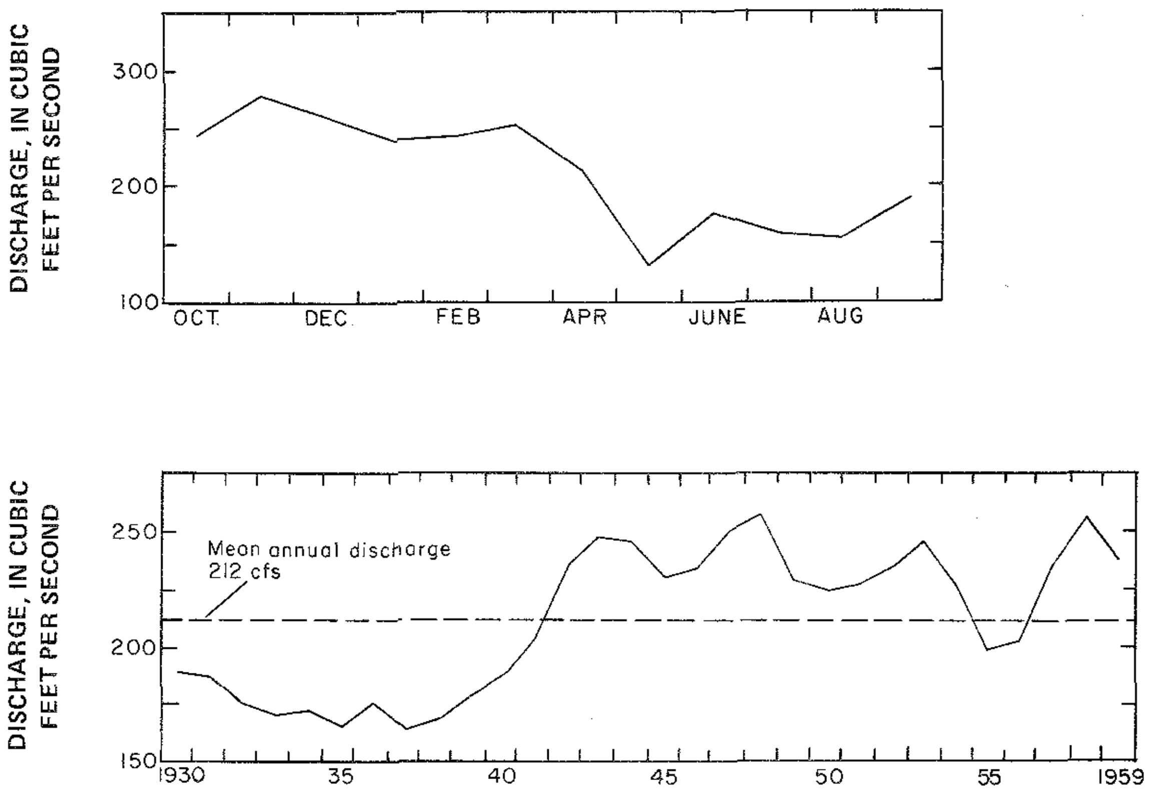

FIGURE 9. Annual and mean monthly discharges of Pahsimeroi River near May, 1930-59.

A flow-duration curve of the mean daily discharge of the Pahsimeroi River near May is shown in figure 10. The curve shows the percent of time during which specified discharges were equaled or exceeded in a given period. For example, as shown in figure 10, during 1930-59, a daily mean flow of about 300 cfs was equaled or exceeded 10 percent of the time.

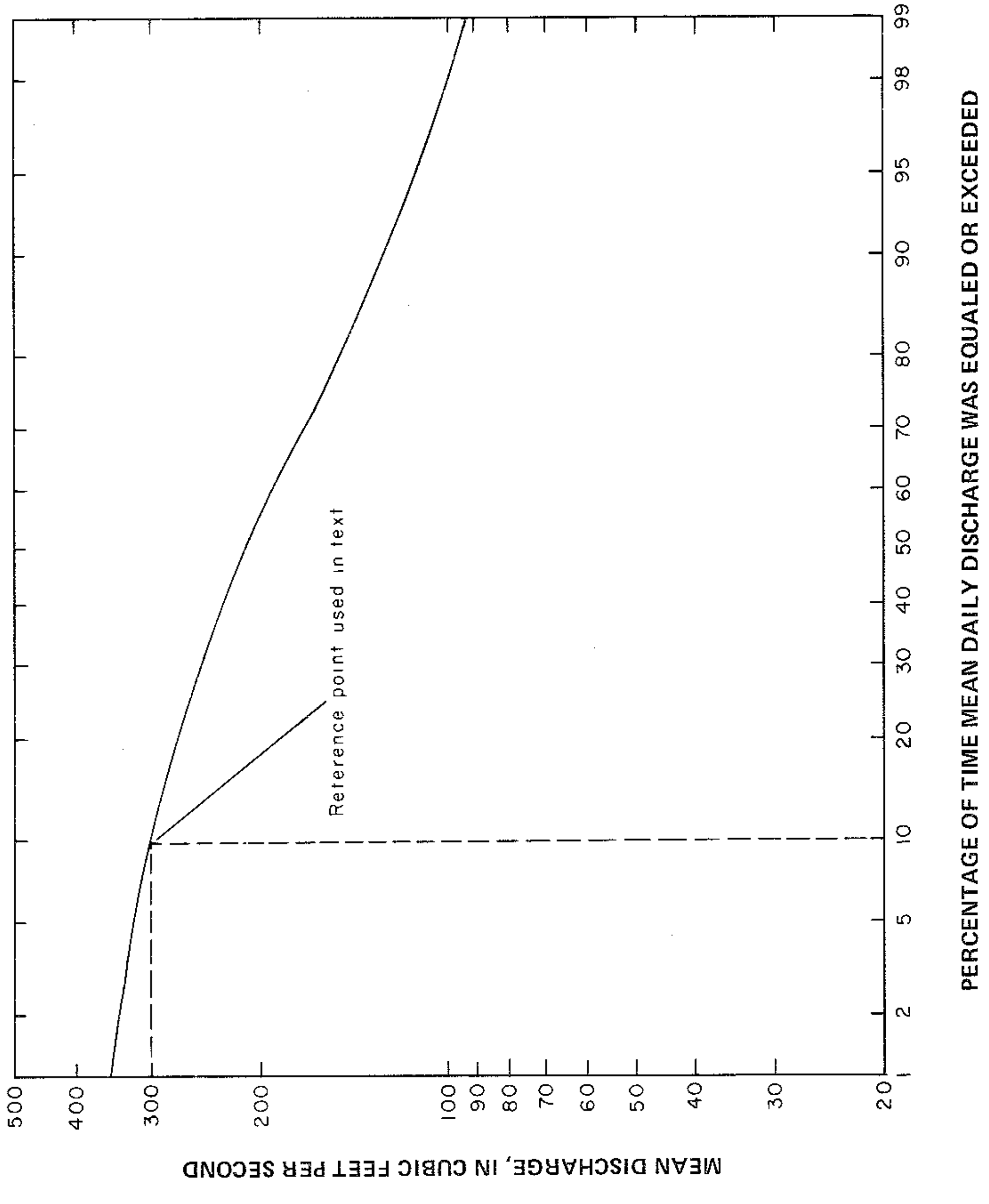

FIGURE 10. **Flow-duration curve of daily flow for Pahsimeroi River near May, 1930-59.**

Figures 11 and 12 show the high and low flow frequency curves for the Pahsimeroi River near May for the 1930-59 water years. The curves were drawn using the log-Pearson Type III procedure (Water Resources Council, 1967). An example of their use is given in figure 11 which shows that a 7-day mean discharge in excess of 290 cfs occurs on the average of once in about 2 years and a 60-day mean discharge in excess of the same magnitude occurs on the average of once in every 2.9 years. Figure 12 shows that a 7-day low mean discharge of less than about 102 cfs occurs on the average of once every 2 years while a 60-day low mean discharge of less than 102 cfs occurs once in 22 years

Figure 13 is a flood-frequency curve for the Pahsimeroi River near May computed using the log-Pearson Type III procedure. Figure 13 shows that a peak discharge of about 460 cfs may be expected, on the average, to be equaled or exceeded once every 10 years. In other words, there is a 10 percent chance of a peak of this magnitude occurring during any given year.

Peripheral Inflow

To establish a basis for estimating the surface-water contribution to the valley by streams flowing from the surrounding mountains, a series of discharge measurements was made on seven tributary streams just above the point where they begin to lose water to their alluvial fans. Measurements were made once each month from April through December 1971 on three streams flowing from the Lemhi Range and on four streams flowing from the Lost River Range.

The three streams measured, which originate in the Lemhi Range, are Big, Patterson, and Morse Creeks. The Big Creek site (13301500) is 0.3 mile upstream from the old continuous-record site of the same number shown on figure 8. Patterson Creek is a new measuring site, while Morse Creek (13301700) is a crest-stage gage at which measurements were made during the 1962-71 water years.

The four streams flowing from the Lost River Range for which measurements were made are Grouse, Meadow, and Sulphur Creeks and the Pahsimeroi River below the confluence of the East Fork and West Fork (Pahsimeroi River below forks, near Dickey). This latter site was visited only from May through October because winter travel conditions prevented visits prior to or after that time. Discharge measurements on all seven streams are listed in table 3 along with those for the Pahsimeroi River near May (13302000), the continuous-record gage site.

Estimates of monthly mean flow for the seven subbasin streams measured (fig. 7) were computed using the method proposed by Riggs (1969). This method is a correlation technique whereby a discharge measurement near mid-month on the stream of interest and concurrent data for a nearby stream with a continuous record are used to calculate the flows

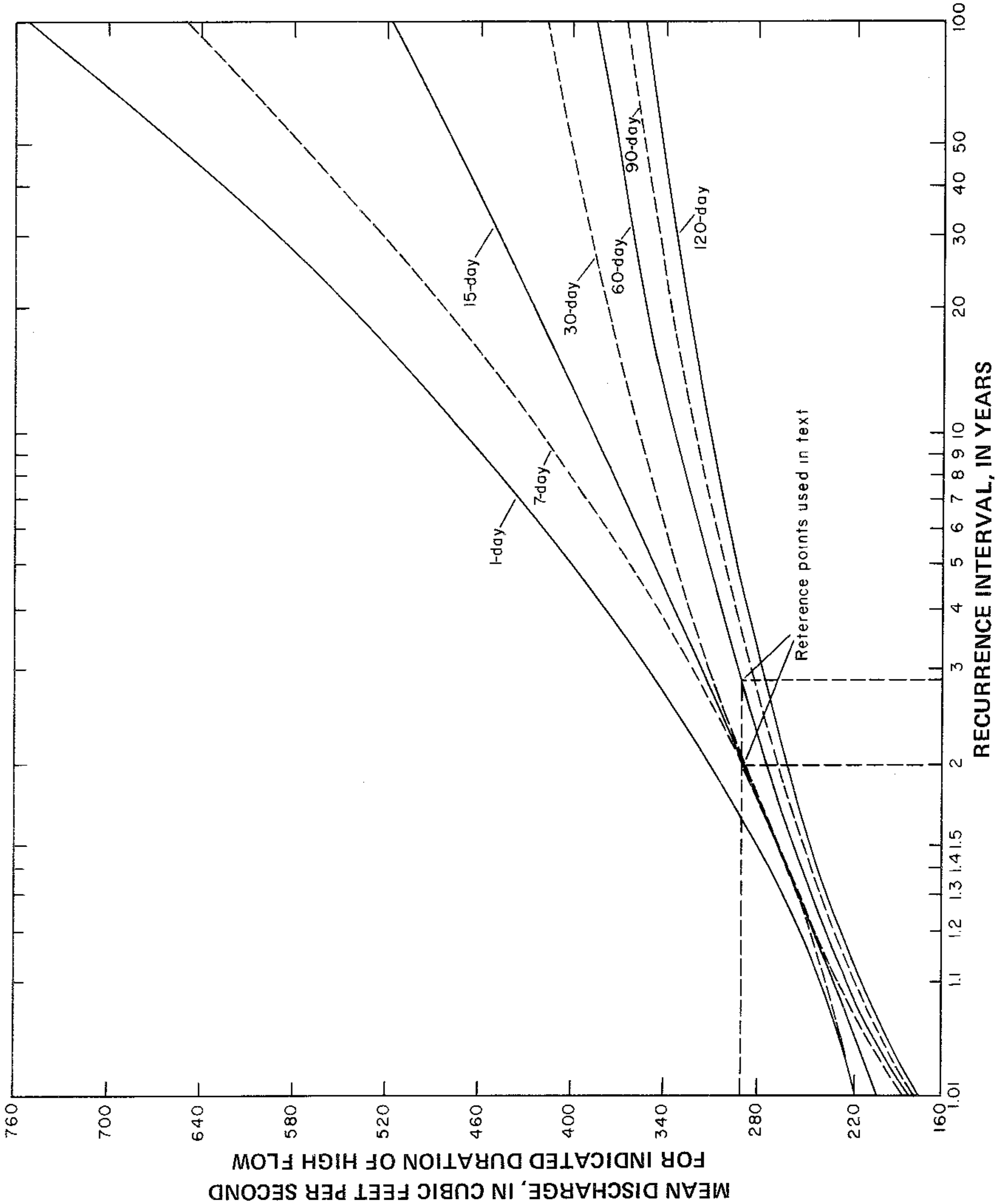

FIGURE 11. High-flow frequency curves for Pahsimeroi River near May, 1930-59.

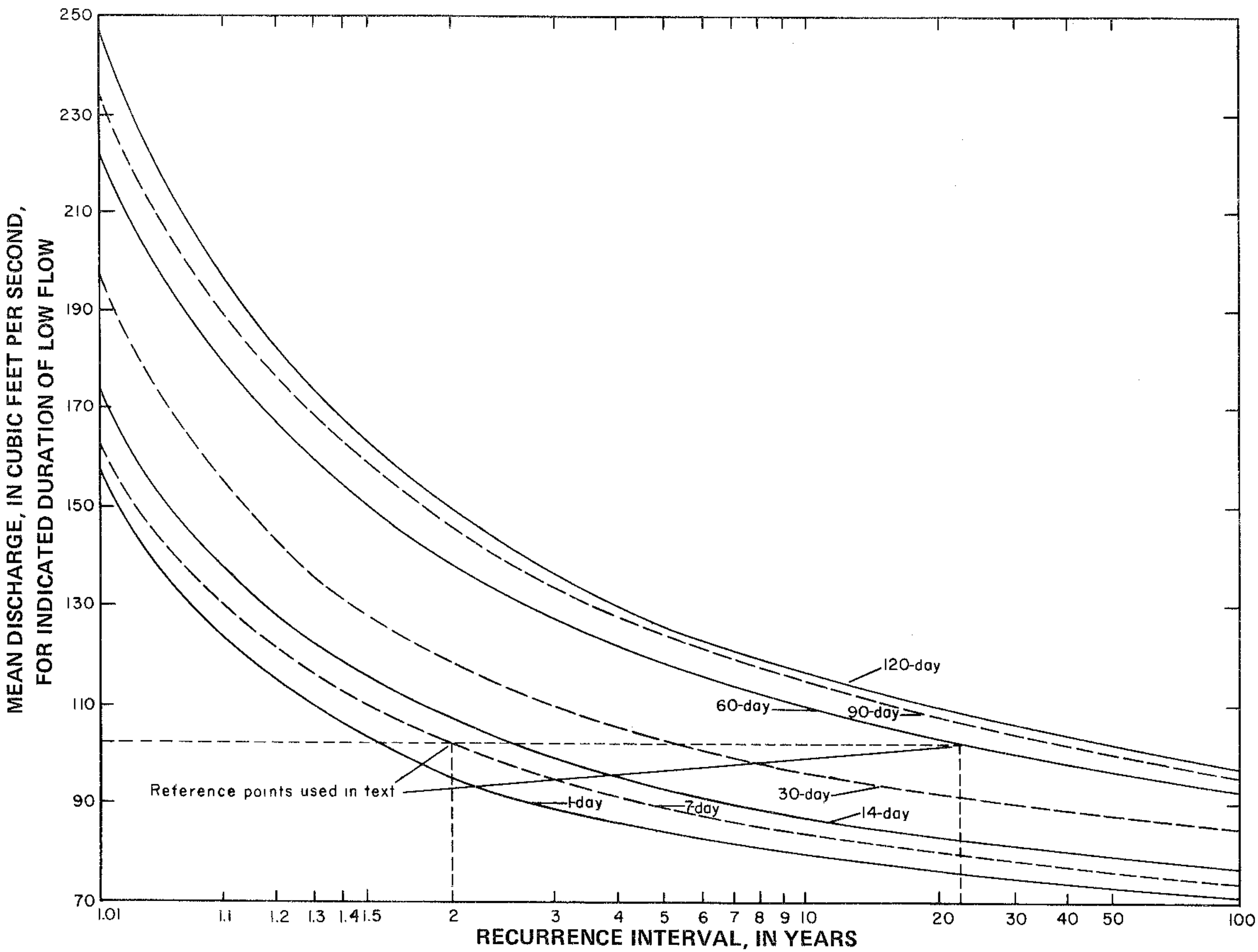

FIGURE 12. Low-flow frequency curves for Pahsimeroi River near May, 1930-59.

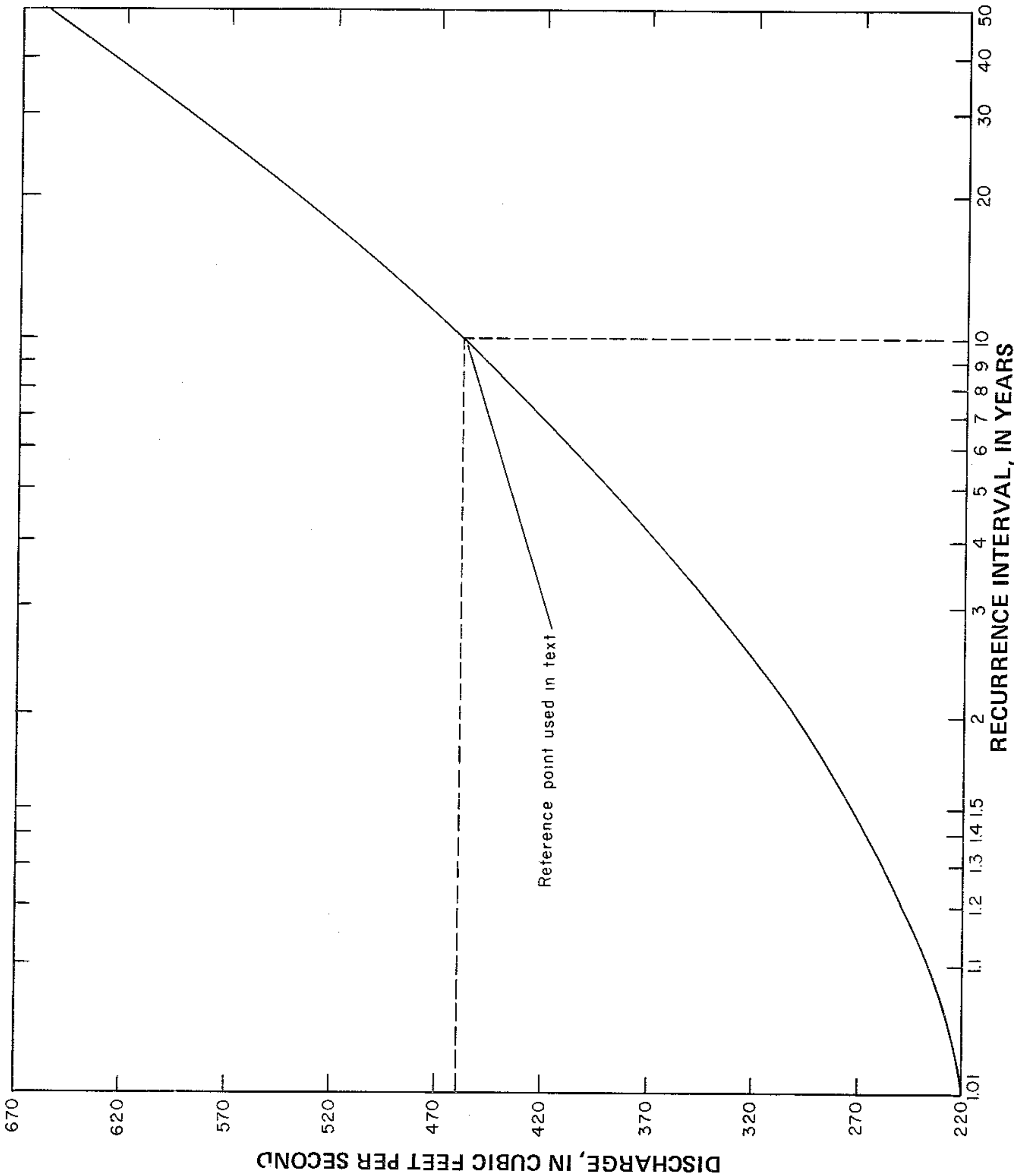

FIGURE 13. Magnitude and frequency of floods on the Pahsimeroi River near May.

TABLE 3

DRAINAGE BASIN CHARACTERISTICS, MONTHLY DISCHARGE MEASUREMENTS AND SPECIFIC CONDUCTANCE FOR THE PAHSIMEROI RIVER AND SELECTED TRIBUTARIES, APRIL TO DECEMBER, 1971

Station	Drainage Area, Square Miles	Mean Altitude, Feet Above Mean Sea Level	Monthly Discharge Measurement in CFS / Specific Conductance, in Micromhos per Centimeter at 25°C								
			April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Pahsimeroi River below forks, near Dickey	30.1	9,490		24.3 / 359	141 / 217	115 / 187	44.6 / 215	23.8 / 267	20.7 / 271		
Big Creek near Patterson	54.8	8,740	20.2 / 112	52.8 / 75	308 / 51	112 / 59	54.5 / 82	32.3 / 85	25.8 / 87	22.5 / 93	24.0 / 98
Grouse Creek near May	26.4	8,550	.49 / 223	1.58 / 258	4.96 / 273	.14 / 364	.37 /	.88 / 221	1.16 / 220	0 /	0 /
Meadow Creek near May	10.1	8,150	.68 / 358	2.72 / 300	2.24 / 311	1.19 / 315	.47 /	.50 / 340	.73 / 322	.44 / 348	.40 / 339
Sulphur Creek near May	9.28	6,980	1.70 / 203	1.91 / 199	1.75 / 200	.88 / 288	.51 /	.80 / 221	1.19 / 226	.82 / 219	.76 / 213
Patterson Creek at Patterson	31.4	8,740	12.3 / 151	53.8 / 100	200 / 69	91.5 / 85	40.8 / 107	23.5 / 128	15.8 / 132	16.0 / 144	13.1 / 152
Morse Creek above diversions, near May	18.0	8,200	11.8 / 48	39.2 / 31	95.7 / 22	28.9 / 30	12.6 / 42	8.16 / 53	6.75 / 50	6.38 / 56	6.46 / 64
Pahsimeroi River near May	845			138 / 364	186 / 392	197 / 383	169 / 378	203 / 384	288 / 376	355 / 359	289 / 347

of interest. In this study, the records of station 13117300 (Sawmill Creek near Goldburg), which is located in the Little Lost River basin (fig. 7), were used for correlation with the streams in the Pahsimeroi River basin. The results for the seven subbasins are shown in table 4.

Seven important subbasins were not included in the monthly measurement schedule because they lacked suitable measurement sites. Estimates of monthly mean discharge were made for them using different methods. For the subbasins south of Doublespring Creek on the west edge of the valley and continuing around the east edge of the valley to Morgan Creek, the method used was to plot the monthly mean flows for Pahsimeroi River below forks and Big, Patterson, and Morse Creeks in cubic feet per second per square mile against mean altitude for the respective subbasin. The curves derived from the relationship were used to estimate discharge from unmeasured basins. A unique curve was used to estimate discharge for each month. The estimated discharges are shown in table 4.

Trail and Lawson Creek basins north of Doublespring Creek on the west side of the valley were estimated by a different method. The monthly unit discharges for Sulphur Creek were assumed to be directly applicable to the two basins because of their similarity in basin characteristics. The Sulphur Creek monthly unit discharge multiplied by the drainage areas of these two streams was used to estimate the monthly mean discharges as shown in table 4.

Discharges for a number of the other subbasins were not estimated for several reasons. The two largest subbasins not estimated were Doublespring Creek and Goldburg Creek. Doublespring Creek generally has no surface outflow. A spring, Doublespring, emerges near the mouth of the canyon but is promptly diverted. The lack of surface outflow from the subbasin, as noted by Meinzer (1924), results from seepage of runoff into the alluvium which extends to the summit of Doublespring Pass and up its tributary canyons (fig. 3). The magnitude of seepage losses to alluvium is shown by the results of a series of discharge measurements made on Big Creek in November 1971. This study was made to give some indication of the extent of the percolation loss to the alluvium of the Pahsimeroi valley floor during a period of low flow and of little or no evaporation loss. The discharge of Big Creek where it enters the valley floor was 22.5 cfs and 6 miles downstream the flow was 7.3 cfs, an average loss of 2.6 cfs per mile. One and a half miles farther downstream, there was no flow.

An estimate of the mean monthly flow for Goldburg Creek, which has surface discharge the year around, was not made because it is basically a ground-water fed stream and correlation with other streams in the area would be inappropriate. Monthly measurements of Goldburg Creek are included in the appendix at surface-water section 3.

The estimated total monthly flow, in acre-feet, to the valley by the peripheral streams that were included is listed at the bottom of table 4.

TABLE 4

ESTIMATED MONTHLY MEAN DISCHARGE OF SELECTED SUBBASINS IN THE PAHSIMEROI RIVER BASIN,

MAY TO DECEMBER 1971

	Estimated Monthly Mean Discharge (cubic feet per second)							
Subbasin	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Pahsimeroi River below forks[a]	39.6	180	128	47.0	25.0	19.8	(b)	(b)
Mahogany Creek[c]	18	78	44	17	9	7	7	6
Burnt Creek[c]	38	116	47	19	11	8	8	7
Big Creek[a]	85.5	380	123	55.5	34.2	25.8	24.4	26.2
Grouse Creek[a]	2.4	5.5	.2	.4	.9	1.2	0	0
Meadow Creek[a]	4.1	2.5	1.2	.5	.5	.7	.4	.4
Sulphur Creek[a]	2.9	2.0	.9	.5	.8	1.2	.8	.8
Trail Creek[d]	3	2	.9	.5	.8	1	.9	.8
Patterson Creek[a]	87.5	257	102	42.5	26.0	15.8	17.3	14.3
Falls Creek[c]	50	136	44	19	12	8	9	8
Morse Creek[a]	59.5	123	30.3	13.7	9.0	6.8	6.9	7.0
Tater Creek[c]	17	39	9	4	3	2	2	2
Lawson Creek[d]	5	3	2	.9	1	2	1	1
Morgan Creek[c]	78	171	26	14	11	6	7	8
Total (rounded)	490	1,495	559	235	144	104	85	82
Total monthly flow in acre-feet	30,130	88,960	34,370	14,450	8,570	6,390	5,040	5,010

[a] Estimated by Riggs method (H. C. Riggs, 1969).
[b] No measurement.
[c] Estimated by unit discharge-mean elevation relationship.
[d] Estimated by Sulphur Creek unit discharge data.

Surface-water runoff is several orders of magnitude higher from the Lemhi Range than it is from the Lost River Range. Assuming equal precipitation on each range, this difference in the surface runoff is probably due to a difference in the rock types making up these ranges. The Lemhi Range is composed principally of impermeable clastic rocks while the Lost River Range is composed mainly of permeable carbonate rocks that readily absorb precipitation.

The seven subbasin streams which were measured monthly were also sampled for water-quality characteristics. Included in table 3 are specific conductance values for samples taken at the time of each monthly discharge measurement. In addition, samples were taken in June during high flow and again in October during low flow for standard chemical analysis. The results of these determinations are given in table 5. They are also summarized in figure 14 by means of diagrams (Stiff, 1951). These diagrams show the concentrations of certain ions in milliequivalents per liter. Milliequivalents per liter is a unit for expressing the concentration of chemical constituents in terms of the interracting values of the electrically charged particles, or ions, in solution. Milligrams per liter is converted to milliequvalents per liter by multiplying by the reciprocal of the combining weight of the ion. The patterns shown present a graphic illustration of the types of waters in an area and their similarity or dissimilarity is easily determined. Thus, the patterns in figure 14 tend to indicate the strong influence of the geology on the chemical character of the waters of the Pahsimeroi River drainage. Streams with low concentrations of dissolved solids issue from the Lemhi Range with its predominance of clastic rocks; streams with higher concentrations of dissolved solids flow from the Lost River Range which is composed principally of carbonate rocks. The presence of the Challis Volcanics in the northwest corner of the study area may be reflected in the slightly higher sodium concentrations in the waters from that area.

Generally, streams are expected to have a higher concentration of dissolved solids during low-flow periods than during high-flow periods. This is because the low flow is composed chiefly of ground-water discharge (base flow). High flows usually result from snowmelt or rainfall that has flowed directly into the drainage system through the soil or over the land surface. This direct runoff has relatively low concentrations of dissolved solids. All the streams sampled in this study show the usual relationship between low flows and high flows except Grouse Creek. In Grouse Creek, the concentrations of dissolved solids decreased as the discharge of the stream decreased. Specific conductance of water samples collected at the time of monthly discharge measurements also showed this trend (table 3), except for July.

In addition to the standard chemical analyses mentioned above, three water samples were taken in October (low flow) for minor elements analysis. These analyses were made to help define some of the effects of mining activity on the water quality in the Pahsimeroi River drainage. Because most of the mining activity appears to have centered in the Patterson Creek subbasin, two of the samples were taken on Patterson Creek, one above and one below the site of the major mining activity. The third sample was collected from Morse

TABLE 5

CHEMICAL ANALYSES OF WATER IN THE PAHSIMEROI RIVER BASIN

(CHEMICAL CONSTITUENTS IN MILLIGRAMS PER LITER)

ANALYSES BY: U. S. GEOLOGICAL SURVEY

Location or Designation	Salinity Diagram No.	Sample Collection Date	Discharge (cfs)	Temperature (°C)	Silica (Si)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Phosphate (PO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved Solids: Res. at 180°C	Dissolved Solids: Calculated	Dissolved Solids Tons Per Ac.-Ft	Dissolved Solids Tons Per Day	Hardness: as $CaCO_3$	Hardness: Noncarbonate	Specific Conductance	pH	Color	Alkalinity as $CaCO_3$	Percent Sodium	Sodium Absorption Ratio	Remarks
Ground Water																															
16N 20E 25bdd1	1	10-12-71		12.0	23	0.02	0.01	47	15	21	2.0	251	0	17	0.09	8.4	0.2	0.35		259	0.35		180	0	434	7.5		206	20	0.7	
15N 21E 21abc1	2	10-11-71	[a]50	10.5	14	0.01	0	39	14	5.5	.9	170	0	27	.06	6.8	.2	.69		194	.26		150	16	323	7.7		139	7	.2	Flowing well
15N 22E 31bcb1	3	10-11-71		10.5	10	.02	.01	16	11	7.2	1.2	111	0	8.8	.18	5.4	0	.79		118	.16		85	0	206	7.1		91	15	.3	
14N 21E 3aba1	4	11-15-71		12.5	26	.02	0	37	14	64	6.3	317	0	31	.06	8.9	.9	.32		345	.47		150	0	562	7.3		260	47	2.3	
14N 22E 22bac1	5	10-12-71		13.0	16	.02	.01	53	14	8.0	1.6	225	0	15	.15	5.5	.1	.64		227	.31		190	5	382	7.6		185	8	.3	
14N 23E 22dcb1	6	10-12-71		13.5	7.7	.03	0	12	8.9	5.5	.9	88	0	11	.06	1.6	.2	.17		92	.13		67	0	169	7.5		72	15	.3	
13N 22E 11aac1	7	10-12-71		12.0	17	0	.02	68	20	10	2.4	313	0	19	.03	6.7	.2	.30		299	.41		250	0	516	7.4		257	8	.3	
Surface Water																															
Pahsimeroi River below forks, near Dickey	8	6-15-71	141	6.0	4.1			29	9.6	3.4	.4	131	0	12	0	1.7	0	.20		156	.21	59.4	110	4	217	8.0		107	4	.1	
	9	10-15-71	21	1.5	4.5			36	12	1.2	.6	148	0	29	0	1.0	.2	.09		158	.21	8.83	140	18	271	8.0		121	2	0	
Big Creek near Patterson		6-16-71	308	6.0	8.8			3.9	2.5	2.0	.6	28	0	2.3	.06	1.8	0	.35		37	.05	30.8	20	0	51	7.3		23	17	.2	
		10-13-71	26	5.5	8.6			7.3	5.4	2.3	.6	55	0	2.0	.03	.9	0	.04		54	.07	3.76	40	0	87	7.7		45	11	.2	
Grouse Creek near May	10	6-14-71	5.0	12.5	7.1			45	6.8	.4	.7	165	0	18	.12	1.9	0	.21		162	.22	2.17	140	5	273	8.1		135	1	0	
	11	10-13-71	1.2	5.0	5.9			33	6.9	1.0	.5	134	0	6.8	.06	1.0	.2	.12		122	.17	.38	110	1	220	8.0		110	2	0	
Meadow Creek near May	12	6-14-71	2.2	13.0	21			39	12	6.9	1.1	205	0	6.3	.09	4.6	0	.14		192	.26	1.16	150	0	311	8.2		168	9	.2	
	13	10-13-71	.73	5.0	19			40	14	8.1	1.0	207	0	0	0	4.4	.1	.06		189	.26	.37	160	0	322	8.2		170	10	.3	
Sulphur Creek near May	14	6-14-71	1.8	14.5	28			22	6.4	9.7	1.0	122	0	5.5	.21	5.2	0	.28		139	.19	.66	81	0	199	7.7		100	20	.5	
	15	10-13-71	1.2	4.5	28			25	6.8	11	.9	132	0	5.5	.09	5.7	.2	.19		149	.20	.48	90	0	226	7.7		108	21	.5	
Patterson Creek at Patterson		6-15-71	200	6.0	6.0			5.8	4.2	1.1	.4	44	0	6.0	.03	1.5	0	.07		47	.06	25.4	32	0	69	7.4		36	7	.1	
	16	10-13-71	16	6.5	6.9	.01	.20	11	8.0	2.7	1.0	69	0	11	0	1.5	.2	.15		78	.11	3.33	60	4	132	7.6		57	9	.2	
Morse Creek above diversions, near May		6-15-71	96	4.0	5.8			2.2	1.1	.7	.4	14	0	2.8	.06	1.4	0	.05		22	.03	5.68	10	0	22	7.2		11	13	.1	
		10-13-71	6.8	4.0	7.0	.02	0	4.9	2.4	1.3	.7	29	0	2.0	0	1.2	0	.05		34	.05	.62	22	0	50	7.3		24	11	.1	
Pahsimeroi River near May	17	6-20-71	186	12.5	22			45	16	11	2.1	232	0	18	.15	7.9	0	.43		238	.32	120	180	0	392	7.9		190	12	.4	
	18	10-13-71	288	10.5	18			45	16	10	2.0	219	0	19	.06	7.6	.2	.25		227	.31	177	180	0	376	8.2		190	11	.3	
		11-18-71	356	5.0	17			46	15	8.7	1.9	202	0	14	.03	8.4	.2	.22		198	.27	190	180	11	359	8.1		166	10	.3	
Springs																															
14N 21E 25bcb1S Sulphur Creek Spring	19	10-12-71	15	14.5	11	.02	0	42	18	6.8	1.9	195	0	49	.03	2.8	.2	.16		228	.31	9.23	180	19	385	7.7		160	8	.2	
14N 23E 16c1S Unnamed Spring		10-12-71		9.0	11	.03	0	8.3	5.6	2.6	1.0	51	0	5.5	.02	1.7	.1	.31		61	.08		43	2	96	7.7		42	11	.2	
12N 22E 24a1S Rock Spring	20	8-10-54	[a]10	5.5	4.1	0		28	5.6	.9	2.0	102	0	8.6	.10	.8	.2	.5	98	101			93	9	177	8.0	2	0	2	0	Radio-chemical analysis available

[a] Discharge reported in gallons per minute.

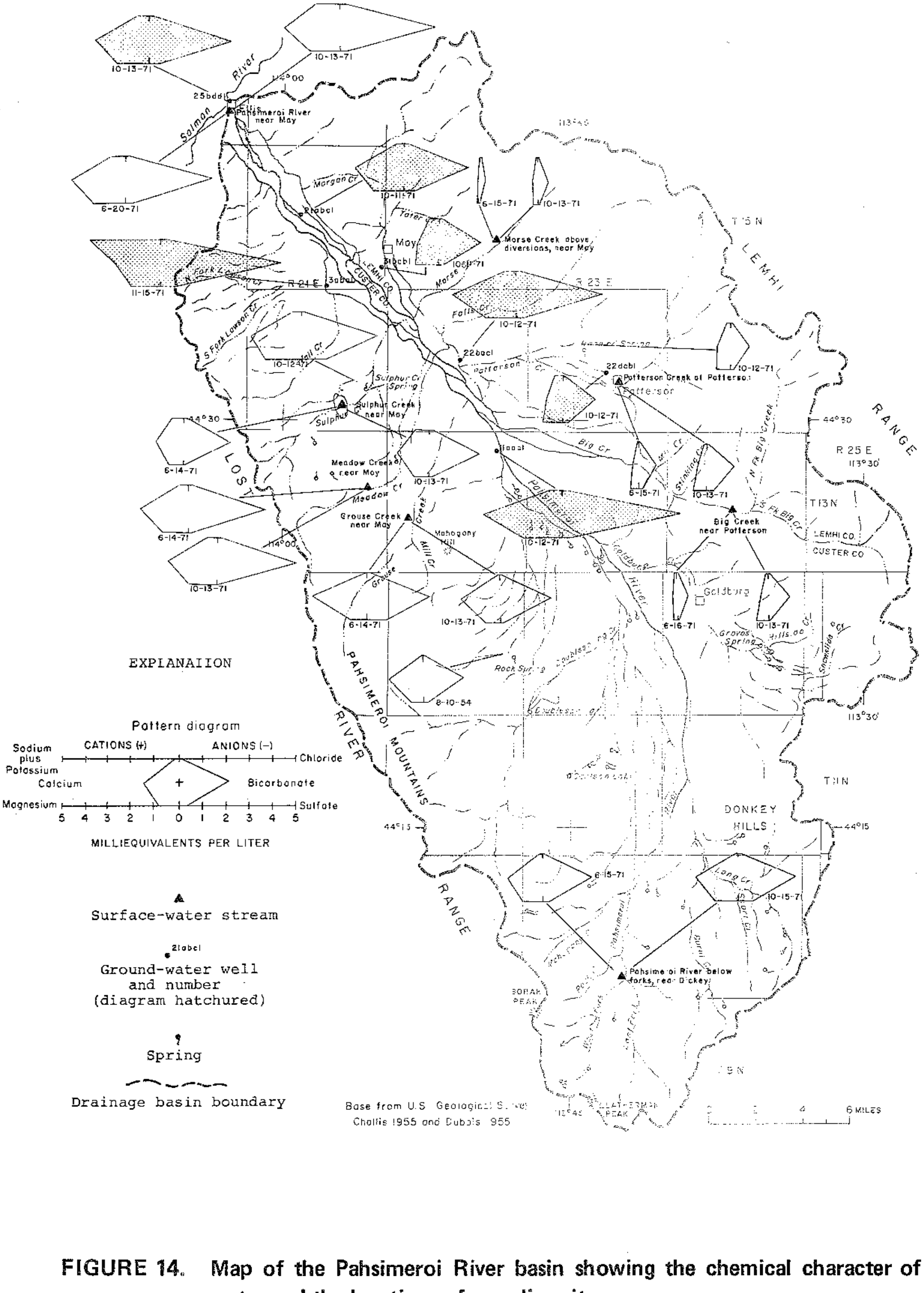

FIGURE 14. Map of the Pahsimeroi River basin showing the chemical character of the water and the locations of sampling sites.

TABLE 6

CHEMICAL ANALYSES OF WATER FOR MINOR ELEMENTS IN SELECTED TRIBUTARIES TO THE PAHSIMEROI RIVER

(CHEMICAL CONSTITUENTS EXPRESSED IN MICROGRAMS PER LITER)

ANALYSES BY: U. S. GEOLOGICAL SURVEY

Location	Sample Collection Date	Discharge (cfs)	Temperature (°C)	Aluminum (Al)	Iron (Fe)	Manganese (Mn)	Strontium (Sr)	Lithium (Li)	Chromium (Cr)	Nickel (Ni)	Copper (Cu)	Lead (Pb)	Zinc (Zn)	Cobalt (Co)	Arsenic (As)	Cadmium (Cd)	Barium (Ba)	Vanadium (V)	Silver (Ag)	Beryllium (Be)	Selenium (Se)	Molybdenum (Mo)	Boron (B)	Mercury (Hg)
Patterson Creek near Patterson	10-13-71	15	5.0		10	100	140	0	0	0	1	0	20	0		0	0	0	0	0	9	0		0.1
Patterson Creek at Patterson	10-13-71	16	5.5	200	10	200	130	30	0	4	11	0	80	2	3	3	200	4.3	0	0	5	9	20	.1
Morse Creek above diversions, near May	10-13-71	6.8	4.0	300	20	0	40	40	0	2	2	1	30	2	2	0	0	0	0	0	4	3	10	.6

Creek to serve as a control in the event that mining activity upstream of the sampling site (above major mining activity) had rendered upper Patterson Creek invalid as an indicator of natural conditions. The results, as shown in table 6, indicate that in no sample did the analyzed constituents exceed the limits of drinking-water standards established by the U. S. Public Health Service (1962). However, a substantial increase in the concentrations of 10 of the 18 commonly analyzed minor elements occurred between the two sampling sites on Patterson Creek. This increase in the concentration of certain minor elements is probably due to either past or current mining activity along the creek.

Sediment samples collected in June during the high runoff period indicate that the seven measured subbasins contribute only slight amounts of suspended sediment to the Pahsimeroi River. The results of the analyses are given in table 7.

TABLE 7

SUSPENDED SEDIMENT IN THE PAHSIMEROI RIVER AND SELECTED TRIBUTARIES

Station	Date	Water Temperature (°C)	Discharge (cfs)	Concentration (mg/l)	Suspended Sediment Discharge (tons per day)
Pahsimeroi River below forks, near Dickey	6-15-71	6.0	141	21	7.99
Big Creek near Patterson	6-16-71	6.0	308	21	17.5
Grouse Creek near May	6-14-71	12.5	4.96	197	2.64
Meadow Creek near May	6-14-71	13.0	2.24	38	.23
Sulphur Creek near May	6-14-71	14.5	1.75	38	18
Patterson Creek at Patterson	6-15-71	6.0	200	32	17.3
Morse Creek above diversion, near May	6-15-71	4.0	95.7	19	4.91
Pahsimeroi River near May	6-20-71	12.5	186	18	9.04

Flow in the Pahsimeroi River

In order to measure the outflow of the Pahsimeroi River basin, the gaging station Pahsimeroi River near May (13302000) was reactivated. This station, 0.3 mile above the mouth, presumably measures all flow leaving the Pahsimeroi River basin at the mouth (see section on Ground Water Discharge). Daily discharge data (June 1971 through May 1972) for this station are to be published in Water Resources Data for Idaho, Part 1. Surface Water Records, 1971 and 1972. A summary of this data in hydrograph form is shown in figure 15 for the period June through December 1971. The same figure shows the monthly mean discharge for the months of June 1971 through December 1971 and the mean monthly discharge for June through December for the previous period of record (1930-59). A comparison of these curves in figure 15 shows the 1971 monthly mean discharges to be 11.7 to 26.5 percent greater than the long-term averages.

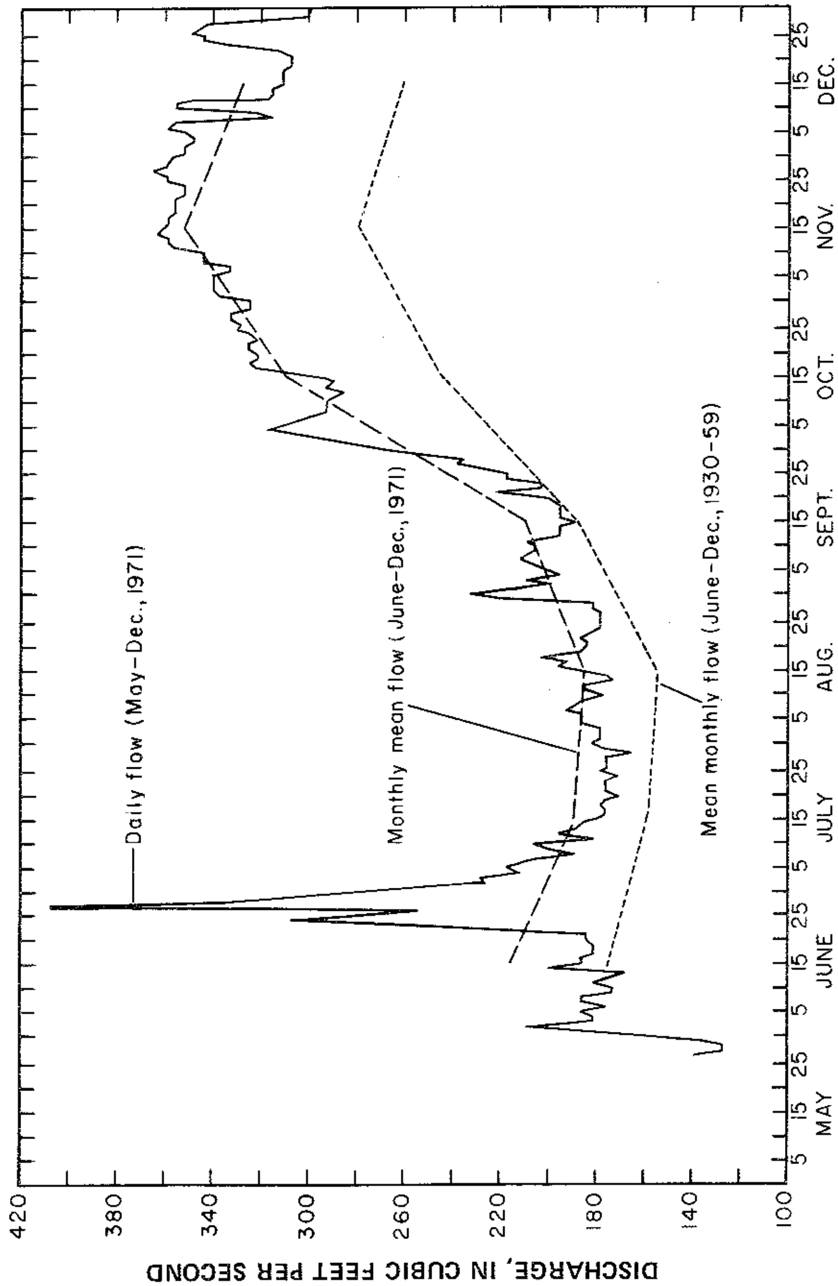

FIGURE 15. Daily and monthly flows for the Pahsimeroi River near May.

Water-quality analyses of high flow (November), medium flow (October), and low flow (June) for the Pahsimeroi River near May are given in table 5. Little difference in the water quality was noted, except a slight increase in concentration of dissolved solids as streamflow decreased. The chemical character of this water is shown in figure 14. Table 5 also lists water temperatures at the time the samples were collected. The higher water temperature at the Pahsimeroi River near May station in October, as compared with October temperatures at other stations (fig. 5), shows the influence of ground-water discharge on the flow of the Pahsimeroi River near the mouth.

Sediment samples were collected in June. These data (table 7) indicate that about 10 tons of suspended sediment leaves the basin per day at 186 cfs discharge. Since 186 cfs is near the mean annual discharge and since the discharge of the river does not vary greatly, the average daily sediment load probably is about 10 tons. This indicates that at least 3,600 tons of suspended sediment leaves the basin annually.

In general, the Pahsimeroi River as it leaves the basin is a ground-water fed stream. The slope of the curves in figures 10 and 15, the higher concentrations of dissolved solids, and the higher water temperatures during the fall and winter months when compared to nearby streams all tend to support this interpretation.

Ground Water

Occurrence

Ground water occurs in virtually all the geologic formations in the Pahsimeroi River basin. The areal extent of these formations is shown in figure 3, and their hydrologic properties are given in table 2.

Ground-water occurrence in the consolidated rocks is generally in the fractures, weathered zones, and solution openings. The solution openings are principally in the carbonate rocks of the Lost River Range and commonly they are the source for the springs and seeps near the mountain fronts. Contribution to streamflow by the springs is most noticeable in the late summer months. However, because the ground-water aquifers in the consolidated rocks of the basin are of minor importance, the following discussion will be limited to the occurrence of water in the alluvial aquifer.

The most important aquifer in the basin comprises the alluvial sand and gravel deposits of Quaternary age. The thickness of the alluvial materials in the basin ranges from a few tens of feet to about 3,000 feet. All wells inventoried were completed in the alluvium with the maximum depth of penetration for any one well being about 350 feet. Physical data for all inventoried wells are listed in table 8.

TABLE 8

RECORDS OF WELLS IN THE PAHSIMEROI RIVER BASIN

Altitude: Altimeter reading.

Well finish: 0 open end; P - perforated casing, T - sand point; X - open hole.

Method drilled: C - cable tool; D - dug; V driven.

Use of water: I - irrigation; H - domestic; S - stock; U - unused.

Remarks: Log - driller's log available, see logs of wells; CA chemical analysis available; Yield, M measured yield in gpm (gallons per minute); Yield, R - reported yield from driller's log.

Well Number	Land Surface Altitude Above Mean Sea Level	Reported Depth of Well, Feet Below Land Surface	Casing: Diameter (inches)	Casing: Feet Below Land Surface to First Perforations	Well Finish	Method Drilled	Year Completed	Water Level: Feet Below Land Surface	Water Level: Date Measured	Horse Power of Pump	Use of Water	Remarks
16N-20E-25bdd1	4,650	115	6	60	X	C	1967	31.59	10-12-71	3/4	H	Log; CA; yield, R - 300 gpm
36bab1	4,661	6	1 1/2	4	T	V	1971	1.58	10-12-71		U	
36bdd1	4,680	13	1 1/4	11	T	V	1971	10.38	10-12-71		U	
16N-21E-31bcb1	4,694	35	6		P	C	1969	8.17	10-11-71	1/2	H	
31cca1	4,717	43	6		P	C	1969	10.39	10-12-71		U	
15N-20E- 1aab1	4,711		4					12.85	10-11-71	1/3	H	
1adc1	4,748							40.13	10-12-71		U	
15N-21E- 6bab1	4,746	42	6		P	C	1970	28.76	10-11-71	3/4	H	
8dbd1	4,808		6					21.08	10-12-71		U	
13adc1	5,115	165	6		X	C	1960	80.51	10-11-71		H	
17bac1	4,793	70	4			C		4.58	10-12-71		H	
21aad1	4,857		6					10.03	7- 1-71	1/2	H	
21abc1	4,833	130	6	115	P	C	1968				H	Log; CA; flows; yield, M - 50 gpm
21bdd1	4,864	40	6		P	C	1964	12.37	10-11-71	1/2	H	
23cbd1	4,918	18	30			D		5.80	10-11-71	1/2	S	
24bcd1	5,027		6			C		24.99	10-11-71	1/2	H	
25daa1	5,069	150	20	30	P	C	1966	20.77	10-11-71	25	I	Log; yield, M - 1,140 gpm
34baa1	4,955	80	4			C		38.28	10-11-71	1/2	H	
15N-22E-19cac1	5,114	90	16		P	C	1966	25.56	10-11-71	20	I	Yield, M - 332 gpm, sprinkler system
29bcb1	5,266	243	6		O	C	1965	75.51	10-12-71		S	Log; yield, R - 600 gpm
30bcc1	5,077	30	30			D		18.00	10-12-71		H	
31bcb1	5,048	117	6			C		12.18	11-11-71	1/2	H	CA
14N-21E- 2bca1	5,008	55	6			C		27.48	10-11-71	3/4	H	
3aba1	4,983	20	5			C		3.31	10-11-71		H	CA
12bba1	5,047	199	16	46	P	C	1968	37.62	10-12-71		U	Log; yield, R - 2,400 gpm

TABLE 8 (Cont'd.)

RECORDS OF WELLS IN THE PAHSIMEROI RIVER BASIN

Well Number	Land Surface Altitude Above Mean Sea Level	Reported Depth of Well, Feet Below Land Surface	Casing: Diameter (inches)	Casing: Feet Below Land Surface to First Perforations	Well Finish	Method Drilled	Year Completed	Water Level: Feet Below Land Surface	Water Level: Date Measured	Horse Power of Pump	Use of Water	Remarks
14N-21E-13dbb1	5,151		6			C	1967	96.50	10-12-71		H	
24aca1	5,247	350	20	180	P	C	1966			350	I	Yield, M - 1,910 gpm, sprinkler system
24cab1	5,282	170	6			C	1969	140.42	10-12-71		H	
14N-22E- 6dba1	5,077	144	20	20	P	C	1966	29.60	10-12-71		U	Log, original depth 192 feet; yield, R - 1,620 gpm
6dbd1	5,074	160	16	52	P	C	1968	31.19	10-11-71	75	I	Log
8acb1	5,102	3	24			D		.85	10-12-71		U	
9cdd1	5,146	12	48			D		9.55	10-12-71			
15bcc1	5,169		4					3.71	10-12-71	1/2	H	
17dcc1	5,123	33	30			D		23.17	10-11-71		U	
18dba1	5,122	154	20	90	P	C	1961	56.16	10-12-71	60	I	Log; yield, R - 1,750 gpm
21cab1	5,182	141	20	20	P	C	1955	10.87	10-11-71	100	I	Log; yield, M - 3,850 gpm
21ddc1	5,198	26	48			D		19.56	10-12-71		U	
22bac1	5,194	40	6			C	1969	6.62	10-12-71		H	CA
22dba1	5,211		4					3.92	10-12-71		S	
27dbb1	5,241	67	36			D		33.86	10-12-71	1/2	H	
35bbd1	5,291	260	16			C		37.91	10-12-71		U	
14N-23E-18ada1	5,486		6			C		153.65	10-12-71		U	
22dcb1	5,946	263	10			C		164.87	10-12-71		H	CA
22dda1	6,061		14					44.18	10-12-71		U	
35bcc1	5,791	213	7	57	P	C	1955	129.59	10-12-71		U	
13N-22E-11aac1	5,423	49	6					24.20	10-12-71		H	CA
12aac1	5,451	20	48			D		6.23	10-12-71		U	
13bab1	5,455	307	20	20	P	C	1966	10.82	10-12-71		U	Log; yield, R - 450 gpm
23dab1	5,526	122	7			C		12.10	10-12-71		U	
13N-23E-28cab1	5,717	16	48			D		6.48	10-12-71		U	
29ada1	5,677	87	16	23	P	C	1966	14.46	10-12-71	30	I	Log; yield, M - 1,380 gpm
35ccb1	5,871	46	4			C		17.58	10-12-71		U	
13N-24E-31cdd1	5,954	6	32			D		.87	8-24-71		U	
12N-23E- 2bbc1	5,908	100	20	0	P	C	1966	28.80	10-12-71	40	I	
12N-24E- 8cda1	6,123	24	4			C		13.26	10-12-71		U	
22bdd1	6,240	7	36	0	0	D		5.71	10-12-71		U	

Ground water in the alluvial aquifer occurs both under water-table and artesian conditions. All inventoried wells (table 8) except well 15N-21E-21abc1 show water-table characteristics. Although well 15N-21E-21abc1 has artesian characteristics, a comparison of chemical and temperature data (table 5) of well 15N-21E-21abc1 with water-table wells showed no significant differences.

Source

The alluvial aquifer of the Pahsimeroi River basin is recharged chiefly by percolation losses from surface streams and irrigation canals and ditches as they cross the coarse valley-fill materials. The carbonate and volcanic rocks of the Lost River Range (fig. 3) may also transmit significant volumes of water directly to the alluvial aquifer (Feth, 1964). Recharge to the alluvium also occurs by downward percolation of applied irrigation water and precipitation on the valley floor.

Fluctuation and Movement

Ground-water levels in the Pahsimeroi River basin are shown by hydrographs of 10 wells in figure 16. The locations of these wells are shown in figure 17. As shown in figure 16, the records available are insufficient to show one complete annual cycle. Since long-term trends for the basin are unknown, it is possible to interpret these fluctuations only by comparing them with annual trends observed in similar basins.

Generally, the water levels in an alluvial aquifer, not influenced by artificial recharge or discharge, start to rise in early spring in conjunction with spring runoff. This rise continues into early summer when a peak occurs followed by a gradual decline in the water levels caused by increasing evapotranspiration losses and decreasing recharge. This decline continues into fall and winter at which time water levels are at their lowest. The water levels remain fairly stable through the winter until the spring runoff again affects the ground-water system. The larger annual fluctuations usually occur in the areas of greater recharge or discharge.

Application of irrigation water can have a strong influence on the annual water-level fluctuations. In areas of surface-water irrigation, water levels tend to peak in late summer; in areas of ground-water irrigation, the lowest water levels usually occur at that time.

Ground-water levels in the Pahsimeroi River basin respond chiefly to seepage from spring runoff and surface-water irrigation. Precipitation on the valley floor and ground-water pumpage (see section on Water Use, Irrigation) do not significantly affect ground-water levels.

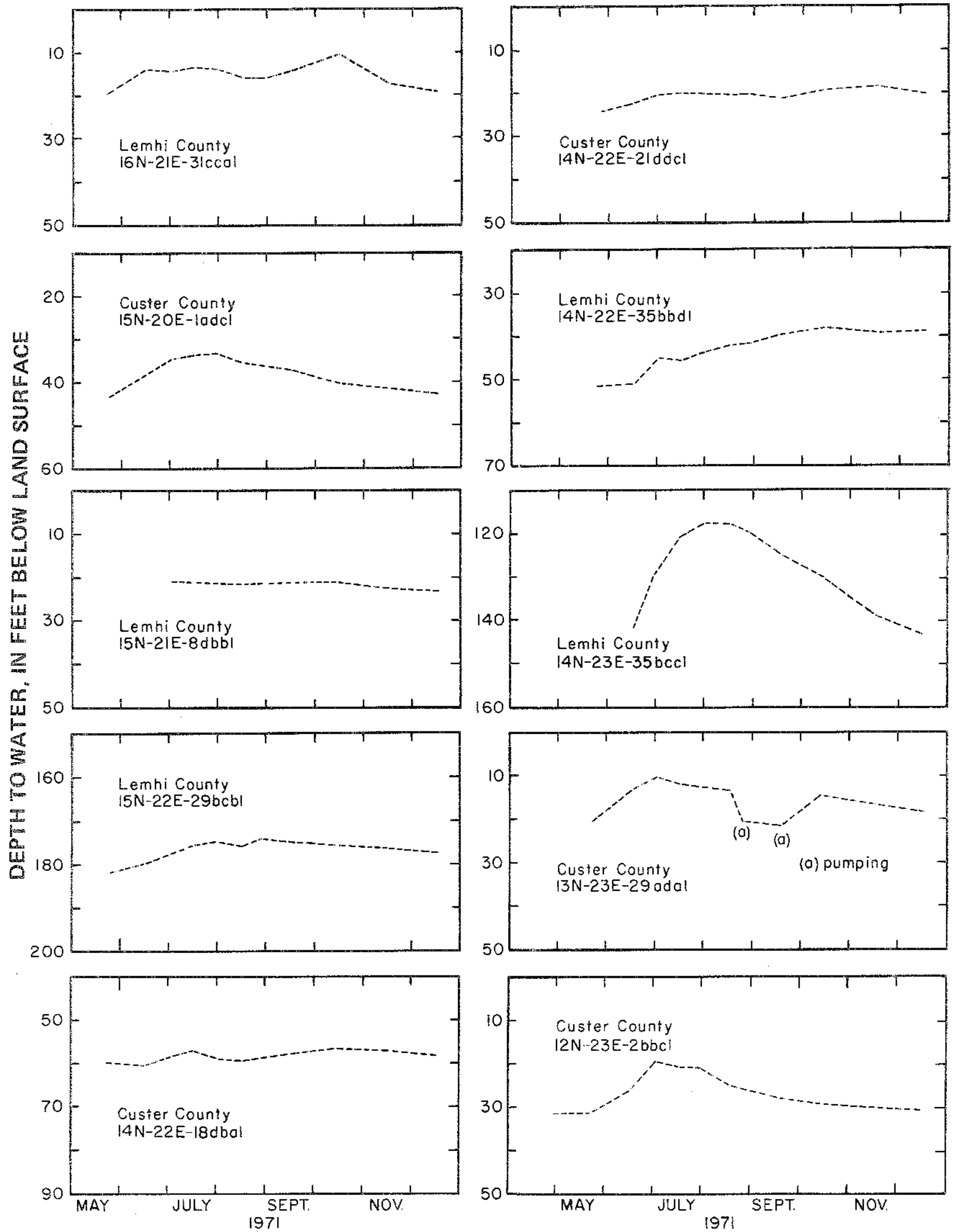

FIGURE 16. Ground-water levels in selected wells in the Pahsimeroi River basin.

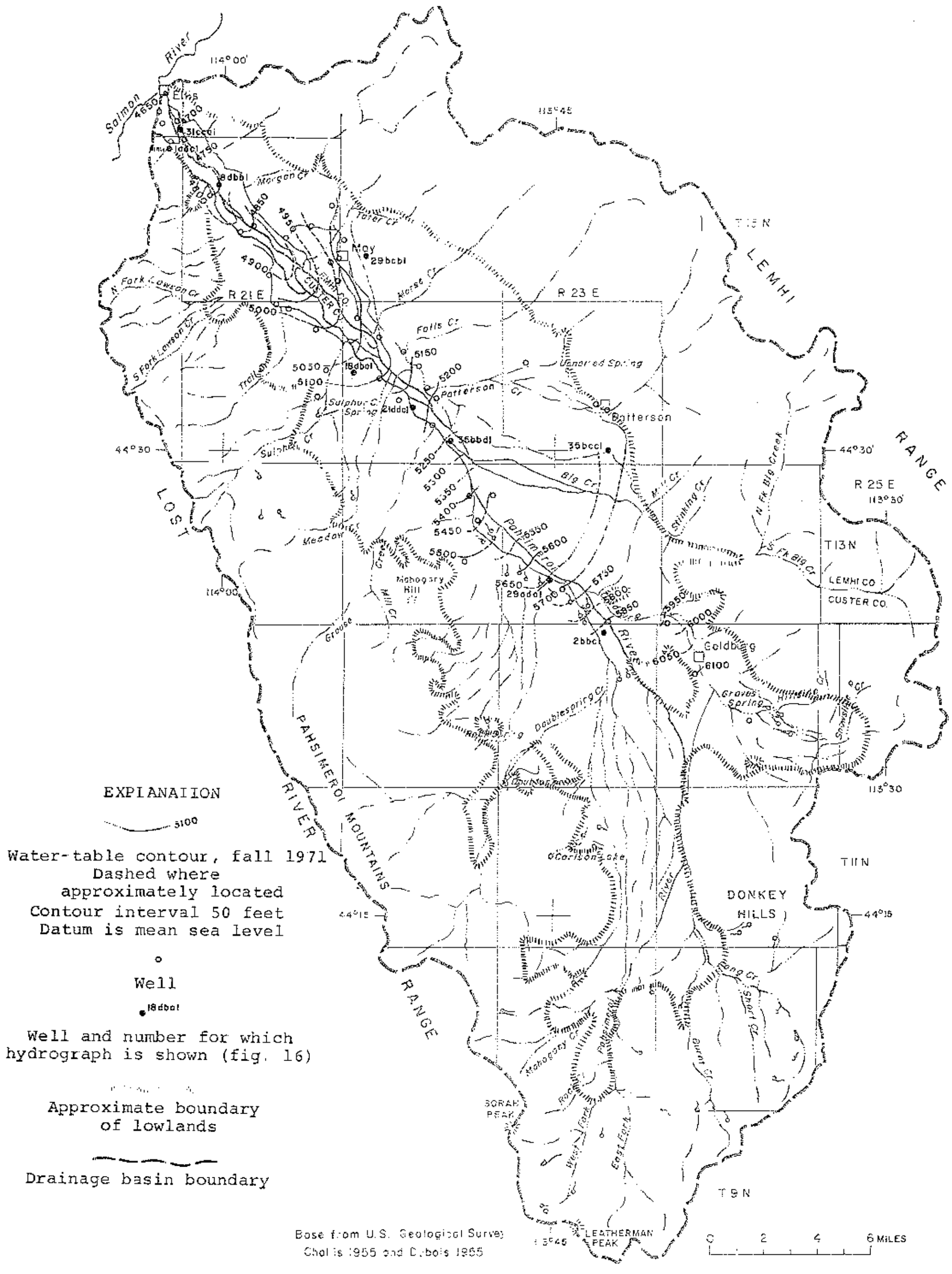

FIGURE 17. Contours on the water table, fall 1971, and well locations.

Water-level fluctuations in the wells shown in figure 16 ranged from about 25 feet (14N-23E-35bcc1) to about 2 feet (15N-21E-8dbb1). Water-level peaks for wells shown in figure 16 occurred between June and November. The amount of water-level fluctuation and the time of water-level peak or recession in a well are due to the timing and volume of recharge or discharge, the distance between the well, the source of recharge or the area of discharge, and the hydrologic properties of the aquifer

Ground water is constantly moving downgradient from areas of recharge to areas of discharge. The position of the water table in the Pahsimeroi River basin in October 1971 is shown in figure 17. Note that the water table is shown only along the axis of the valley because well data are not available in the remainder of the valley. Ground-water movement is downgradient and at right angles to these contours. As shown by some of the contours, ground water in the basin moves from areas of recharge near the mountain fronts toward the axis of the valley and then downvalley to areas of discharge.

Well Yields and Aquifer Characteristics

Discharge measurements were made at all five irrigation wells which were being pumped in the Pahsimeroi River basin in 1971. The measured yields for both sprinkler and gravity systems (table 9) ranged from 332 to 3,850 gpm (gallons per minute). Specific capacity, defined as the yield per foot of drawdown, was computed for four of the measured irrigation wells. The values obtained ranged from 106 to 203 gpm per foot of drawdown and averaged 152 gpm per foot of drawdown.

An estimate of transmissivity of an aquifer can be made from specific capacity values if a storage coefficient can be estimated. Transmissivity as defined by Lohman and others (1972) is the rate at which water of the prevailing kinematic viscosity is transmitted through a unit width of the aquifer under a unit hydraulic gradient. The storage coefficient, also defined by Lohman and others (1972), is the volume of water an aquifer releases from or takes into storage per unit surface area of the aquifer per unit change in head.

Assuming that an average specific capacity of 152 gpm per foot of drawdown and a storage coefficient of 0.20 is representative of the aquifer, a transmissivity of about 30,800 square feet per day (230,000 gallons per day per foot) can be calculated (Theis and others, 1963). This value seems reasonable and possibly conservative when compared with the higher values reported for aquifer tests made in nearby basins containing similar deposits.

Discharge

Ground water is discharged naturally from the alluvial aquifer in the Pahsimeroi River basin by: (1) flow to the Pahsimeroi River (base flow); (2) evapotranspiration; (3) spring discharge; (4) subsurface outflow through the alluvium at the mouth of the Pahsimeroi River; and (5) possibly some interbasin leakage. The principal means of discharge are ground-water flow to the river and evapotranspiration.

To estimate the amount of subsurface outflow leaving the basin at the mouth of the Pahsimeroi River, surface geophysical methods were used to determine the bedrock configuration and depth of the alluvium. The results (fig. 6) indicate that any significant outflow would have to be through the present outlet channel where the alluvium is less than 30 feet deep. To estimate the flow through the alluvium, the following equation was used (Ferris and others, 1962):

$$Q = TIL$$

where

Q = discharge, in gallons per day
T = transmissivity, in square feet per day
I = hydraulic gradient, in feet per mile
L = width, in miles, of the cross section through which the discharge occurs.

Using a transmissivity (T) of 30,800 square feet per day (230,000 gpd per foot), a hydraulic gradient (I) of 22 feet per mile, and a cross-section width (L) of 0.25 miles, subsurface outflow through the alluvium at the cross section near the mouth of the Pahsimeroi River basin is calculated to be 1,265,000 gpd, or less than 2 cfs.

Discharge measurements made of flow in the Salmon River above and below its confluence with the Pahsimeroi River also indicated that no significant volume of water leaves the basin as subsurface outflow.

Although interbasin leakage may occur from and to the Pahsimeroi River basin, the determination of this interbasin leakage was beyond the scope of this investigation.

Springs

There are numerous springs and seeps in the basin. Generally, they occur at the mouths of mountain canyons, along the mountain fronts, at the bases of alluvial fans and stream terraces which are at or slightly above the stream levels, and in the valley lowlands where the water table intersects the land surface. Spring yields range from a few gallons per minute to as much as 7,000 gpm at Sulphur Creek Spring.

Springs are used extensively in the basin as a source of water for domestic and irrigation needs. Chemical analyses of three springs are given in table 5.

Water Quality

Chemical analyses of water from seven wells and three springs are given in table 5. The chemical character of these waters is shown in figure 14 by means of diagrams.

The well and spring waters sampled in the Pahsimeroi River basin are of good chemical quality and are suitable for all present uses. In no sample did the analyzed constituents exceed the limits of drinking-water standards established by the U. S. Public Health Service.

The spring and ground waters in the Pahsimeroi River basin are classified as bicarbonate type. Generally, the water from the northeast side of the basin is of a magnesium bicarbonate type with low concentrations of dissolved solids, while water from the southwest side is a calcium bicarbonate type with slightly higher concentrations of dissolved solids. The only exception to the above is for water from well 14N-21E-3aba1 where a sodium bicarbonate type water was found. Dissolved solids concentrations, a measure of the amount of mineral matter in solution, for all spring and ground waters analyzed in the basin ranged from 62 to 345 mg/1 (milligrams per liter).

Interrelation of Surface and Ground Water

The surface- and ground-water resources of the Pahsimeroi River basin are intricately related. The large exchange of water from the surface to the subsurface and back to the surface is very pronounced and, therefore, important in understanding the availability and nature of the water resources of the basin.

The total amount of surface water flowing across nine selected sections and also in the Pahsimeroi River where it enters the valley floor is shown by hydrographs in figure 18. The locations of these surface-water sections and the Pahsimeroi River below the forks are shown in figure 7. The discharge measurements were made monthly from May to December 1971. Figure 19 shows the apparent gain or loss with time between the sections. The river flow, tributary flow, and irrigation diversions at each section are shown by month in the appendix on pages 53-57.

The flow of the Pahsimeroi River below the forks and the surface-water flow across sections 1 and 2, figure 18, reflect the overland runoff generated from snowmelt in the upper Pahsimeroi River basin. As shown by the hydrographs, peak flows occur in June and July followed by a steady decline which continues into fall.

Surface runoff from the upper Pahsimeroi River basin affects the quantity of flow across section 3 only during periods of peak discharge, normally June and July. The principal source of water crossing section 3 is Goldburg Creek. Most of the water flowing across section 4 is from Goldburg Creek and numerous springs which rise along the toe of

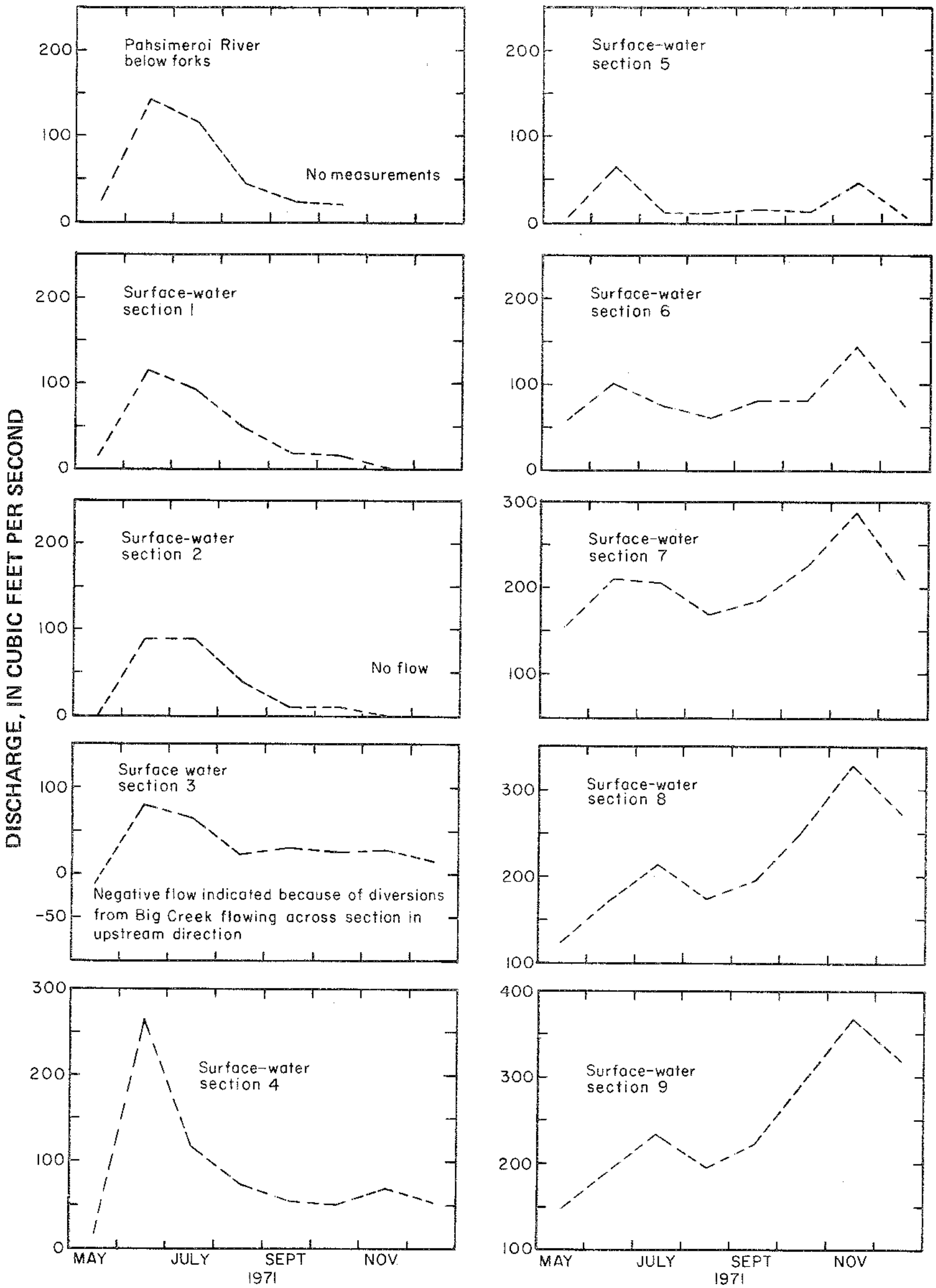

FIGURE 18. Surface-water flow at selected locations in the Pahsimeroi River basin.

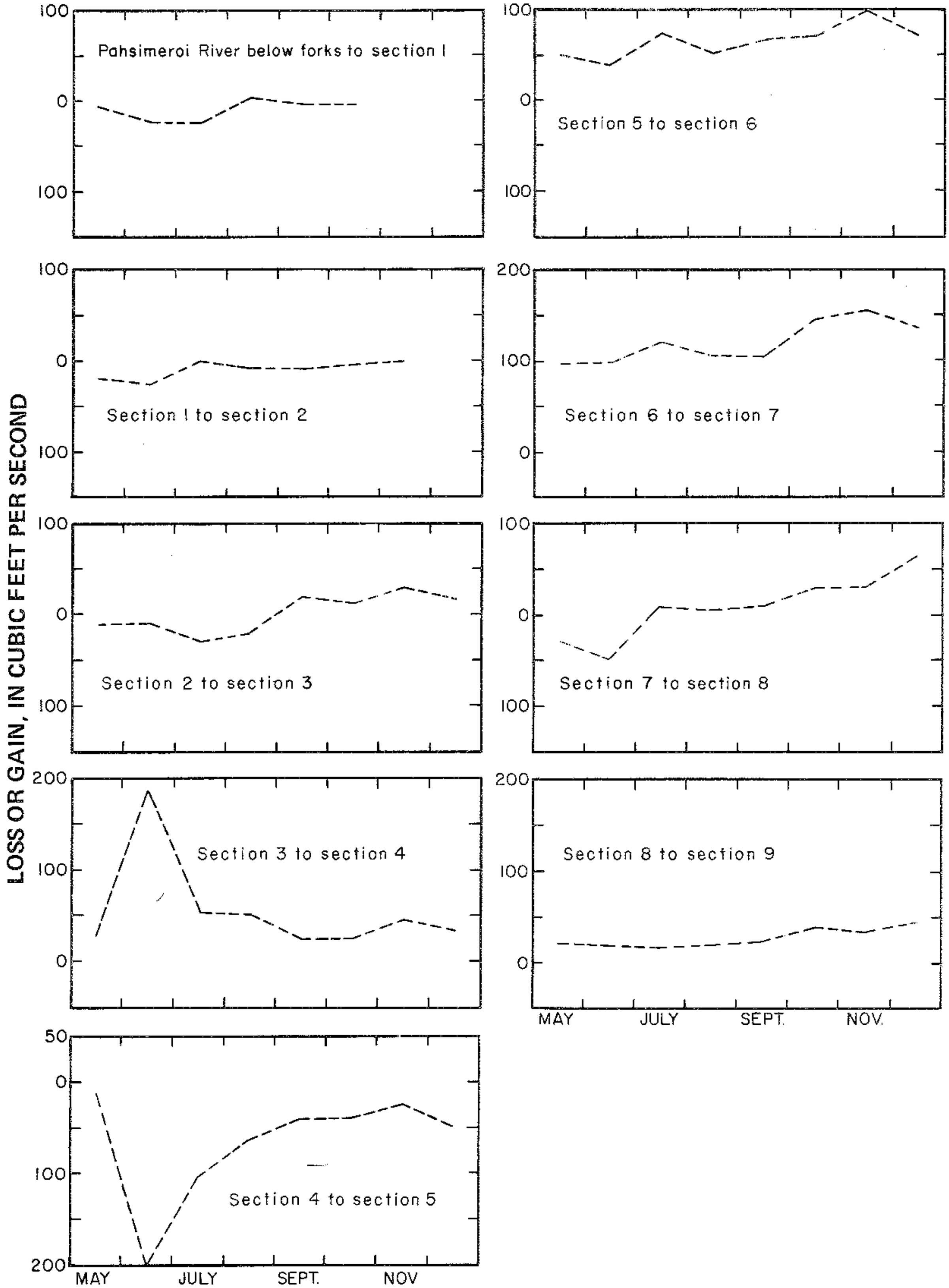

FIGURE 19. Apparent gains or losses between Pahsimeroi River measuring site and surface-water sections in the Pahsimeroi River basin.

Doublespring fan (see fig. 7). The large increase in flow across section 4 in June is from snowmelt runoff from Big Creek; smaller quantities of surface runoff from the upper Pahsimeroi River basin reach this section normally only in June and July The increase in flow across the section in November is from Big Creek. Water previously diverted from Big Creek is now confined to the Big Creek channel.

The amount of water crossing section 5 between May and December indicates that very little of the water from the upper Pahsimeroi River basin and Big Creek reaches this part of the basin as surface flow. Most of the water crossing this section is from Goldburg Creek and the numerous springs located at the toe of Doublespring fan, both above and below section 4. The increase in flow across the section in November is due to the cessation of irrigation diversions between sections 4 and 5. The sharp decrease in flow in December is probably exaggerated by the severe ice conditions that existed at the time of measurement.

Generally, the Pahsimeroi River and its tributaries above section 5 lose to the alluvial aquifer of the valley floor (see fig. 7). The gain from sections 2 to 3 (fig. 19) beginning in September is due to the failure of surface flow from the upper Pahsimeroi to reach section 2 while the flow of Goldburg Creek continues crossing section 3. Goldburg Creek derives most of its flow from ground-water discharge and, therefore, contributes water to the valley more uniformly than does the upper reaches of the Pahsimeroi River. The gain in flow from sections 3 to 4 reflects discharge from Big Creek and the numerous seeps and springs located along the toe of Doublespring fan. These gains tend to conceal the losses of the river and Goldburg Creek to the alluvial aquifer. The springs, located at the toe of Doublespring fan, are believed to be connected with the water table of the basin due to the correlation between their discharges and water-level fluctuations in nearby wells. The losses shown between sections 4 and 5 substantiate the statement that very little of the surface runoff of the upper basin crosses section 5 as surface flow.

The increase in flow shown by hydrographs in figure 18 for sections 6 through 9 is principally from ground-water discharge. The slope of the water table as shown in figure 17 is toward the river downstream from section 5. The apparent increase in flow across sections 6 and 7 in June is probably due to overland runoff from snowmelt from tributaries The decline from June into August is probably due to increasing transpiration losses. The correlation between surface flows crossing sections 8 and 9 in July and August and the water-level fluctuation in well 15N-20E-1adc1 (fig. 16) suggest that these highs and recessions are related at least in part to recharge of the ground-water system in the lower part of the basin.

Water-level fluctuations in four wells located between sections 3 and 5 suggest that a mound of recharge moves through the alluvial aquifer. The highest recorded water level in well 12N-23E-2bbc1 (fig. 16) located near section 3 occurred in July, while the peak in well 14N-22E-21ddc1, section 5, occurred in November. Water levels in four wells located between sections 3 and 5 peaked between July and November.

The large increase in surface flow crossing sections 6 through 9 shown in figure 18, starting in late summer and continuing through November when maximum flows occurred, is probably related in part to the mound of ground-water recharge moving through the valley. As shown in figure 19, the greatest increase in surface water flow occurs in November between sections 5 and 7. The increase in surface flow downstream of section 7 is fairly constant and relatively small. Most of the ground-water recharge moving downvalley evidently reappears at the surface between sections 5 and 7.

Water Use

The principal uses of water in the Pahsimeroi River basin, in order of quantities used, are irrigation, fish propagation, domestic, and livestock. There is no industrial or municipal use of water in the basin.

Irrigation

There are approximately 27,000 acres of irrigated land in the basin (see fig. 7). About 24,500 acres are irrigated with surface water. The remainder is either irrigated by ground water or irrigated with both surface and ground water.

Surface-water diversions from the Pahsimeroi River and its tributaries from May 1 to October 7, 1971, as reported to the Idaho Department of Water Administration totaled about 120,000 acre-feet. To supplement these diversions, 930 acre-feet of ground water were pumped (table 9) to meet irrigation demands. The quantity of surface water diverted, and consequently the amount of supplemental ground water pumped annually for irrigation needs, is directly related to the amount of precipitation received in the mountains during the winter months preceding the irrigation season.

There are no reservoir facilities for the storage of excess surface waters. Therefore, extensive canal systems have been built on most tributaries to facilitate the maximum diversion of the water during high flows. These diversions intercept most of the tributary flow soon after it enters the main valley.

Fish Propagation

The Idaho Fish and Game Department operates acclimatization and propagation facilities for Chinook salmon and steelhead trout in the Pahsimeroi River basin. These facilities, located near the mouth of the Pahsimeroi River, divert approximately 13,000 acre-feet of water annually from the river during the summer and fall months. Virtually all water diverted returns to the river.

TABLE 9

GROUND-WATER-IRRIGATION PUMPAGE IN 1971 AND IRRIGATION-WELL CHARACTERISTICS IN THE PAHSIMEROI RIVER BASIN

		Static Water Level		Discharge Measurements						
Well No.	Reported Well Depth, Feet Below Land Surface	Date	Feet Below Land Surface	Date	Gallons per Minute	Pumping Level, Feet Below Land Surface	Estimated Specific Capacity, Gallons per Minute per Foot of Drawdown[a]	Irrigation Method	Horse Power of Pump	1971 Pumpage (acre-(feet)[b]
15N-21E-25daa1	150	7-29-70	17.73	8-10-71	1,140	27.26	148	Gravity	25	110
15N-22E-19cac1	90	5-21-71	29.91	8-19-71	332	27.39	152	Sprinkler	20	50
14N-21E-24aca1	350			8-25-71	1,910	-		Sprinkler	350	100
14N-22E-21cab1	141	7-12-71	12.52	7-27-71	3,850	47.80	106	Gravity	100	500
13N-23E-29ada1	87	8-16-71	13.39	8-24-71	1,380	20.35	203	Gravity	30	170
Total										930

[a] Drawdown estimated using nearby observation well water-level data.

[b] Pumpage estimated from discharge measurements and power-use data.

Domestic and Stock

Wells and springs are the major source of water for domestic use in the Pahsimeroi River basin. Most stock-water supplies are taken from surface-water sources with smaller quantities coming from wells and springs. The total quantity of water used by the rural population for both domestic and livestock purposes is small, and insignificant when contrasted to the large irrigation usage. Therefore, no attempt was made to estimate this water use.

Water Rights

Water rights and applications for appropriation of water granted by the Idaho Department of Water Administration for both surface and ground waters in the Pahsimeroi River basin as of August 5, 1971, totaled nearly 1,000 cfs. Table 10 shows the amount of allocated water (decrees, licenses, and permits) for principal streams in the basin. Most of these streams receive their flow from the surrounding mountains, the exceptions being the lower Pahsimeroi River, Goldburg Creek, Sulphur Creek below Sulphur Creek Spring, and O'Neal or lower Patterson Creek which derive most of their flow from springs and ground-water discharge.

The relation of the allocated water to the amount of water available for irrigation in the principal streams in the basin can be made by comparing water rights shown in table 10 to estimated monthly mean discharge shown in table 4.

SUMMARY AND RECOMMENDATIONS

The surface- and ground-water resources of the Pahsimeroi River basin are so closely related that for optimum development and use they must be considered a single resource.

Surface-water flow from the Lemhi Range greatly exceeds that of the Lost River Range. Streams draining these two ranges seldom contribute surface flow directly to the Pahsimeroi River because of extensive irrigation diversions and large natural evapotranspiration and percolation losses.

The lower Pahsimeroi River is basically a ground-water fed stream. Maximum mean monthly discharge occurs in November and minimum mean monthly discharge occurs in May. The mean annual contribution to the Salmon River is 212 cfs, or 153,500 acre-feet.

The principal ground-water aquifer is the alluvium of the valley floor. Maximum well penetration in the alluvium is about 350 feet. Principal sources of recharge are seepage from spring runoff and surface-water irrigation. Irrigation wells yield as much as 3,850 gpm and

TABLE 10

WATER RIGHTS (DECREES, LICENSES, AND PERMITS)

IN THE PAHSIMEROI RIVER BASIN AS OF AUGUST 5, 1971

(Water rights reported in cfs)

Source	Decrees	Licenses	Permits	Total
Pahsimeroi River	191.7	49.8	42.5	284.0
Goldburg Creek	14.2	7.8	0	22.0
Big Creek	134.6	43.5	0	178.1
Patterson Creek	30.0	14.4	0	44.4
Sulphur Creek (includes Sulphur Creek Spring)	14.4	5.2	0	19.6
O'Neal Spring or Big Spring Creek[a]	109.2	27.3	0	136.5
Falls Creek	31.6	9.4	0	41.0
Morse Creek	21.0	7.6	3.2	31.8
Morgan Creek	30.0	5.7	0	35.7
Grouse Creek	All	2.2	0	[b]2.2
Potato Creek[c]	6.4	0	0	6.4
Lawson Creek	3.2	1.6	0	4.8
Miscellaneous	61.6	48.1	2.6	112.3
Ground Water	0	13.4	63.0	76.4
Total	[b]647.9	236.0	111.3	[b]995.2

[a] Shown as lower Patterson Creek on map.
[b] Grouse Creek decrees not included in total.
[c] Referred to as Tater Creek on map and table 4.

their specific capacities range from 106 to 203 gpm per foot of drawdown. Ground-water movement is generally from the mountain fronts toward the axis of the valley, and then, downgradient in the direction of the Pahsimeroi River flow.

The ground and surface waters of the Pahsimeroi River drainage are primarily calcium bicarbonate type. No chemically "bad" water was found.

The principal use of water in the basin is for irrigation of hay and pasture grasses. Approximately 120,000 acre-feet of surface water were diverted and about 930 acre-feet of ground water were pumped in 1971 to irrigate 27,000 acres.

The availability of surface water for irrigation each year is dependent upon the amount of precipitation received in the surrounding mountains during the winter months preceding the irrigation season. Adequate surface-water supplies are usually available to meet current demands except in years of abnormally low snowpack. Future agricultural development in the basin will have to utilize increasing quantities of ground water.

To provide data for management of the water resources of the basin, the following recommendations are made: (1) continue operation of the gaging station Pahsimeroi River near May (13302000); (2) install a gaging station on Patterson Creek at Patterson (M13301600); (3) initiate bimonthly measurements of water levels in wells 15N-20E-1adc1, 14N-22E-35bbd1, and 12N-23E-2bbc1; and (4) continue water-quality sampling of the Pahsimeroi River near May at high, medium, and low flows.

LOGS OF WELLS

The drillers' logs of 11 wells in the Pahsimeroi River basin are shown on the following pages. These logs were obtained from the Idaho Department of Water Administration. The terminology is that of the drillers, and has only been slightly modified to give some degree of uniformity.

Logs of Wells

Material	Thickness (feet)	Depth, Feet Below Land Surface
16N-20E-25bdd1 (Casing: 6-inch steel 0 to 60 feet)		
Soil and rock	40	0
Sand, water	5	40
Clay, green	68	45
Gravel, water	2	113
Total depth	–	115
15N-21E-21abc1 (Casing: 6-inch steel 0 to 130 feet; perforated from 115 to 130 feet, 20 perforations 1/16 by 8 inches; flowing well)		
Soil	5	0
Sand, fine, water	20	5
Gravel, fine, water	15	25
Gravel and clay, hardpan, no water	85	40
Gravel, well began to flow	5	125
Total depth	–	130

Material	Thickness (feet)	Depth, Feet Below Land Surface
15N-21E-25daa1 (Casing: 20-inch steel 0 to 150 feet; perforated from 30 to 150 feet, 520 perforations 1/4 by 3 inches)		
Soil	4	0
Gravel and clay, water	45	4
Clay	17	49
Gravel, some clay, water	66	66
Clay, yellow	14	132
Gravel, trace of clay	4	146
Total depth	–	150
15N-22E-29bcb1 (Casing: 6-inch steel)		
Gravel and clay, brown	46	0
Boulders	2	46
Gravel and clay, brown	140	48
Gravel, hardpan	7	188
Gravel, water	3	195
Well deepened to 243 feet, no record	45	198
Total depth	–	243
14N-21E-12bba1 (Casing: 16-inch steel 0 to 199 feet; perforated from 46 to 196 feet, 3,000 perforations 1/4 by 2 inches)		
Soil and rock	8	0
Gravel and clay, mixed	37	8
Gravel, water	10	45
Gravel and some clay, mixed, water	57	55
Boulders	4	112
Gravel and some clay, mixed water	7	116
Gravel, water	3	123
Gravel and clay, mixed, some water	36	126
Gravel, good water	6	162
Gravel and some clay, mixed, water	14	168
Sand, water	2	182
Gravel, water	15	184
Total depth	–	199

Material	Thickness (feet)	Depth, Feet Below Land Surface

14N-22E- 6dba1
(Casing: 20-inch steel 0 to 170 feet; 16-inch steel 160 to 190 feet; perforated from 20 to 170 feet, 375 perforations 3/8 by 8 inches; some of casing has been pulled; present depth of well is 144 feet)

Material	Thickness (feet)	Depth, Feet Below Land Surface
Sand and gravel	18	0
Sand and clay	3	18
Sand and gravel	4	21
Hardpan	3	25
Sand and gravel, water	44	28
Sand, water	4	72
Clay, sand and gravel	9	76
Sand and gravel, water	17	85
Clay	12	102
Sand, gravel, and some clay	21	114
Clay and sand	11	135
Clay, black	8	146
Sand, gravel, and some clay	16	154
Sand and gravel, water	22	170
Total depth, when drilled	—	192

14N-22E- 6dbd1
(Casing: 16-inch steel 0 to 160 feet; perforated from 52 to 152 feet, 2,000 perforations 1/8 by 2 inches)

Material	Thickness (feet)	Depth, Feet Below Land Surface
Sand and gravel	31	0
Sand, gravel and clay, cream color, water	22	31
Sand, gravel and clay, cream color, water	38	53
Gravel and clay, brown	6	91
Sand, gravel and clay, cream color, water	23	97
Sand, gravel and clay, cream color, more sand, water	28	120
Sand, gravel and clay, cream color, firmer, water	12	148
Total depth	—	160

Material	Thickness (feet)	Depth, Feet Below Land Surface

14N-22E-18dba1
(Casing: 20-inch steel 0 to 154 feet; perforated from 90 to 154 feet, 200 perforations 1/2 by 6 inches)

Soil and rock	15	0
Clay and rock	15	15
Clay and rock	15	30
Clay and gravel, some water	15	45
Clay and gravel	15	60
Clay and gravel, water	15	75
Clay and gravel	22	90
Clay and gravel, water raised from 69 to 59 feet, water	18	112
Clay and gravel	24	130
Total depth	—	154

14N-22E-21cab1
(Casing: 20-inch steel 0 to 141 feet; perforated from 20 to 135 feet, 1,700 perforations)

Soil	2	0
Sand and gravel	3	2
Gravel, water struck at 18 feet	103	5
Clay	5	108
Gravel	7	113
Gravel and silt	10	120
Gravel and clay	7	130
Clay	4	137
Total depth	—	141

Material	Thickness (feet)	Depth, Feet Below Land Surface
13N-22E-13bab1 (Casing: 20-inch steel 0 to 165 feet, 16-inch steel 0 to 302 feet; 20-inch casing perforated from 20 to 145 feet; 16-inch casing 30 to 290 feet, perforations 2 by 5 1/8 inches)		
Clay and gravel	8	0
Boulders, water	8	8
Gravel	10	16
Gravel, little water	44	26
Gravel and sand, some water	32	70
Gravel, some water	48	102
Clay and gravel	100	150
Gravel, some water	3	250
Clay and gravel	27	253
Gravel, very little water	2	280
Clay and gravel	25	282
Total depth	—	307
13N-23E-29ada1 (Casing: 16-inch steel 0 to 87 feet; perforated from 23 to 87 feet, 663 perforations 3/8 by 4 inches)		
Soil	2	0
Gravel, dirty	16	2
Gravel with clay streaks, water	14	18
Gravel, water	13	32
Gravel, small, water	30	45
Gravel, large, water	12	75
Total depth	—	87

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APPENDIX

APPENDIX

Summary of Measurements of Surface-Water Sections, Pahsimeroi River Basin

(Measurements reported in cfs)

Section 1

Date	Pahsimeroi River
4-30-71	0
5-23-71	16.8
6-16-71	116
7-14-71	92.8
8-12-71	49.6
9-18-71	20.5
10-15-71	16.0
11-16-71	.19

Section 2

Date	Pahsimeroi River	Diversions
4-30-71	0	0
5-23-71	0	.45
6-16-71	60.4	29.8
7-14-71	54.5	37.6
8-12-71	11.6	29.5
9-18-71	0	12.6
10-19-71	0	12.4
11-16-71	0	0

Section 3

Date	Pahsimeroi River	Goldburg Creek	Diversions	Diversions from Big Creek[a]
5-23-71	0	9.2	0	19.3
6-17-71	56.5	30.7	25.3	31.4
7-14-71	33.0	51.6	19.6	39.8
8-12-71	4.39	46.9	2.89	29.1
9-18-71	2.0	44.7	0	16.4
10-15-71	1.54	40.0	0	15.4
11-16-71	2.44	25.9	0	0
12-15-71	0	17.1	0	0

Section 4

Date	Pahsimeroi River[b]	Big Creek	Springs	Diversions
5-24-71	17.4	0	[c]0.01	.25
6-17-71	93.3	141	.54	30.9
7-14-71	89.5	0	.90	26.5
8-12-71	63.0	0	.51	10.8
9-19-71	54.2	0	.50	.58
10-15-71	51.0	0	[c].2	.37
11-17-17	47.4	17.4	[c].2	.34
12-15-71	31.8	[c]18	[c].05	[c]2.7

Section 5

Date	Pahsimeroi River	Patterson Creek	Diversions	Diversions from Mahogany Creek[a]
4-30-71	16.2	0	0	-
5-24-72	0	0	6.84	-
6-18-71	5.14	4.01	56.2	1 40
7-14-71	0	[c].05	15.9	3.62
8-12-71	0	0	12.7	1.73
9-19-71	0	.24	15.8	1.23
10-15-71	0	2.11	11.2	1.00
11-17-51	44.7	[c]1.2	[c].3	1.10
12-15-71	4.92	[c].1	0	[c].2

Section 6

Date	Pahsimeroi River	Patterson Creek	Sulphur Creek[d]	Diversions
5-24-71	2.00	2.70	5.90	46.3
6-18-71	1.32	10.4	8.67	81.9
7-13-71	7.69	10.6	6.70	50.6
8-11-71	4.06	2.34	7.90	48.1
9-19-71	.92	5.85	13.8	60.8
10-14-71	2.39	13.0	12.6	54.5
11-17-71	44.6	37.0	15.7	45.3
12-16-71	[c]5.3	29.4	14.6	[c]26.0

Section 7

Date	Pahsimeroi River	Diversions
5-25-71	42.0	112
6-19-71	56.0	154
7-13-71	67.0	138
8-11-71	61.3	107
9-20-71	71.3	114
10-14-71	177	49.5
11-17-71	272	14.7
12-16-71	211	0

Section 8

Date	Pahsimeroi River	Diversions
5- 1-71	145	9.40
5-25-71	98 7	26.6
6-19-71	125	46.4
7-13-71	162	52.0
8-11-71	144	30.2
9-20-71	160	36.2
10-14-71	240	15.0
11-18-71	323	5.44
12-16-71	274	[c].6

Section 9

Date	Pahsimeroi River	Diversions
5-26-71	145	2.50
6-20-71	186	3.80
7-12-71	207	24.1
8-10-71	181	12.8
9-20-71	210	10.6
10-14-71	294	2.62
11-18-71	365	[c]4
12-16-71	321	0

[a] Diversions from tributaries flow across section in upstream direction.

[b] Includes Goldburg Creek.

[c] Discharge estimated

[d] Includes Sulphur Creek Spring.